2004 ANNUAL PROGRESS REPORT:

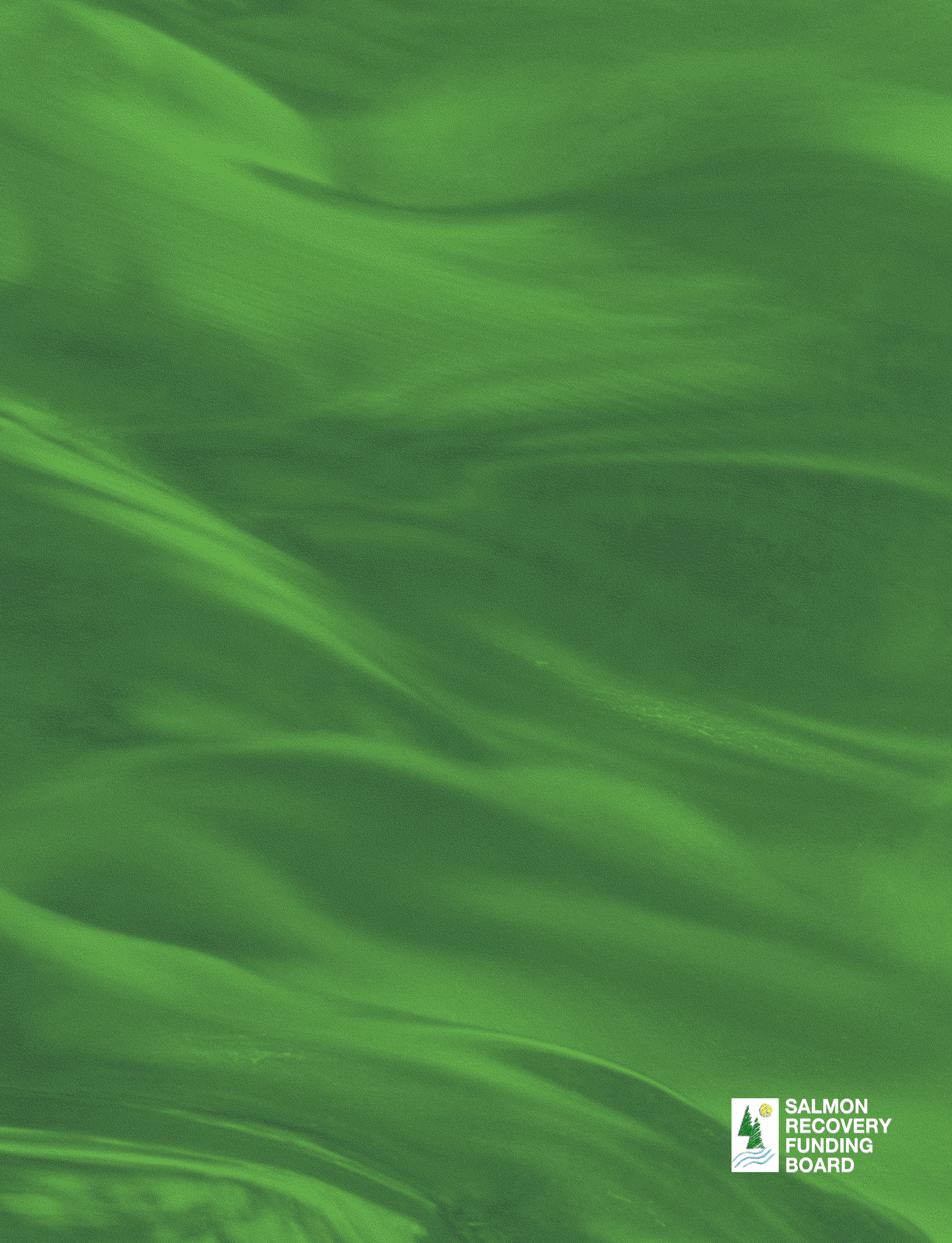
Preliminary Findings

Washington State Salmon Recovery Funding Board

Reach-Scale Effectiveness Monitoring Program

April 2005

SALMON RECOVERY FUNDING BOARD



SALMON
RECOVERY
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Washington State Salmon Recovery Funding Board Reach-Scale Effectiveness Monitoring Program

2004 Annual Progress Report
Preliminary Findings

April 2005

SALMON RECOVERY FUNDING BOARD

Prepared by

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ACRONYMS AND ABBREVIATIONS

ACMA	*Acer macrophyllum*
AIS	Artificially Placed In-stream Structure
ARME	*Arbutus menziesii*
BACI	Before After Control Impact
cm	centimeter
dbh	diameter at breast height
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
EPE	Estimated Position Error
ESA	Endangered Species Act
GPS	global positioning system
IBI	Index of Biotic Integrity
km	kilometer
m	meter
NOAA	National Oceanic and Atmospheric Administration
PCA	principle components analysis
POBA	*Populus balsamifera*
PSME	*Pseudotsuga menziesii*
SASC	*Salix scouleriana*
SRFB	Salmon Recovery Funding Board
THPL	*Thuja plicata*
TSHE	*Tsuga heterophylla*
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDFW	Washington State Department of Fish and Wildlife
WRIA	Watershed Resource Inventory Area

EXECUTIVE SUMMARY

The Washington State Salmon Recovery Funding Board (SRFB) was created by the state Legislature in 1999 to provide grants and loans for salmon habitat projects and salmon recovery activities. The SRFB has funded more than 600 projects and spent over $200 million in state and federal funds toward salmon recovery. There is a need for the SRFB, as well as state and federal government, to have accountability for the effects of these expenditures. It is not economically feasible to monitor the long-term success of every project funded, so projects were grouped into categories. A subset of projects from each category were selected for effectiveness monitoring. The results from this monitoring are expected to provide information about the probable effectiveness of other projects in the same category. In order to determine the relative effectiveness of project categories, the SRFB approved funding for reach scale effectiveness monitoring in October 2003. In April 2004, a contract was awarded to Tetra Tech FW, Inc. (now Tetra Tech EC, Inc.) to monitor selected projects beginning in spring 2004.

Effectiveness monitoring experimental designs and sampling protocols were developed for projects that affected or included: fish passage, in-stream structures, riparian plantings, livestock exclusions, constrained channels, channel connectivity, gravel placement, and diversion screening restoration. The intent of the monitoring was to test whether habitat targeted for restoration had been improved, and for some projects, whether local stream reach abundance of salmon and steelhead had increased. Where structures were part of habitat improvement, engineering specifications were also tested for effectiveness in meeting design criteria over time.

The types of statistical test and sampling frequency varied by project type. Eight categories of habitat restoration projects are being tested using a Before After Control Impact (BACI) experimental design. For fish passage, channel connectivity, and spawning gravel projects, sampling will occur before implementation and at 1, 2, and 5 years post-project implementation. For other restoration project categories, sampling will occur before implementation and at 1, 3, 5, and 10 years post-project implementation. Where important intact habitat has been purchased or placed under easement, the intent of effectiveness monitoring is to test whether that habitat has remained the same or improved over time. Improvement or maintenance of high habitat quality indicates that habitat protection was effective. Because there are no control areas established for habitat protection projects, change over time will be assessed using regression analysis and a non-parametric statistical approach. Sampling will occur at 1, 3, 6, 9, and 12 years post-acquisition.

Field sampling indicators and field sampling techniques were adopted from U.S. Environmental Protection Agency's (EPA's) Environmental Monitoring and Assessment Program (EMAP) (Peck 2003). Not all of the parameters described in EMAP are included in this Reach-Scale Effectiveness Monitoring Program. The selection of indicators was based on their relevance to project objectives for each project category, as well as each indicator's variance and signal to noise ratio. If multiple indicators fulfilled the same objective, those with lower variance and higher signal to noise ratios were selected. These indicators provided a stronger indicator of change than those with higher variance and lower signal to noise ratios.

Each of the nine project types had a specific protocol adapted from EMAP that was used to collect data on attributes designed to detect changes in habitat, fish populations, or ecological status expected to result from project implementation. These data were recorded in the field using digital data forms, and were then uploaded into an office centralized database.

This database, complete with metadata, was compared with data collected in other monitoring programs to ensure compatibility. The field data were then summarized using summary statistics developed for each project type. These summary statistics were entered into the PRISM database maintained by the SRFB to track SRFB-funded restoration projects across the state. A paired t-test for BACI projects will be used to test for changes between control and impact reaches in Year 0 (pre-project) and Year 1 (after implementation) once Year 1 data have been collected. For habitat protection projects, summary statistics will be tracked for change over time using either regression or non-parametric statistical methods.

This Annual Progress Report summarizes the data collected during the 2004 field season. This season's data represent the pre-project implementation, (or "before" year) data for BACI design projects, and the first year of sampling (Year 1) for habitat protection projects. This report contains preliminary findings that will serve as baseline data for future years of data collection. Initial comparison of data to the baseline will occur in the 2005 Annual Progress Report. Trends for some projects will be able to be detected after 2 years, but for other project types it will take longer to detect results. This report includes a description of objectives for each monitoring category, data collection methods for each monitoring category, results from the 2004 season, a description of each project site sampled, planned data analysis, and a cost analysis from the first year of sampling.

1. INTRODUCTION

The Washington State Salmon Recovery Funding Board (SRFB) was created by the Washington State Legislature in 1999 to provide grants and loans for salmon habitat projects and salmon recovery activities. The SRFB has funded more than 600 projects and spent over $200 million in state and federal funds toward salmon recovery. The Washington Comprehensive Monitoring Strategy was written in 2002 to identify monitoring efforts that were occurring in the state and to develop a strategy to coordinate these efforts through state-wide programs. In 2003, the SRFB funded a survey of restoration project sponsors to determine what, if any, monitoring was being done after projects had been implemented. The responses from the survey indicated that project sponsors where implementing a wide variety of monitoring efforts from compliance monitoring, required by the funding agreement, to full-scale monitoring programs that assess physical habitat and fish response to restoration. The inconsistency of these monitoring efforts indicated a need for a coordinated effectiveness monitoring program to independently evaluate the success of funded restoration projects. A repeatable, standardized approach for this evaluation was needed to provide accountability for the expenditures of the state and federal legislatures to further salmon recovery, as well as to help determine the cost-effectiveness of different project categories so that future restoration dollars can be most efficiently spent.

In order to determine the relative effectiveness of project categories, the SRFB approved funding for the Reach-Scale Effectiveness Monitoring Program in October 2003. Tetra Tech FW, Inc. (now Tetra Tech EC, Inc.) was contracted in April 2004 to begin this monitoring at selected projects.

Funding for the Reach-Scale Effectiveness Monitoring Program includes funding from the Pacific Coast Salmon Recovery Fund, a federal funding source for salmon recovery in the Pacific Northwest. This funding is distributed to states with habitat for Pacific salmon including Washington, Oregon, California, Alaska, and Idaho. These states are developing state-wide effectiveness monitoring programs to report back to Congress on the success of restoration efforts. Expanding coordination of these monitoring efforts across the region will give the federal legislation needed information for future funding decisions for salmon habitat restoration. Comparable data collected across the region will also provide better information to aid management decisions for listed salmon species, many of which have habitat that ranges across state lines.

This Annual Progress Report summarizes the data collected during the 2004 field season. This season's data represent the pre-project implementation, (or "before" year) data for BACI design projects, and the first year of sampling (Year 1) for habitat protection projects. This report contains preliminary findings that will serve as baseline data for future years of data collection. Initial comparison of data to the baseline will occur in the 2005 Annual Progress Report. Trends for some projects will be able to be detected after 2 years, but for other project types it will take longer to detect results. This report includes a description of objectives for each monitoring category, data collection methods for each monitoring category, results from the

2004 season, a description of each project site sampled, planned data analysis, and a cost analysis from the first year of sampling.

2. DESCRIPTION OF PROJECT CATEGORIES

Due to the large number of projects (more than 600) that have been funded by the SRFB, it is not economically feasible to monitor every project for effectiveness. Projects were grouped into categories with the intent of drawing conclusions about the effectiveness of the project types, and to extrapolate those conclusions to other similar projects. The projects currently include the categories described in the following paragraphs.

Fish Passage Projects – Include bridges, culvert improvements, dam removals, debris removals, diversion dam passage, fishways, weirs, and water management. The objective for fish passage projects is to increase access to areas blocked by human-caused impediments (Crawford 2004a).

In-Stream Habitat Projects – Include channel reconfiguration, installed deflectors, log and rock control weirs, roughened channels, and wood debris placements. The objective for instream projects is to increase instream cover, spawning, and resting areas by constructing artificial instream structures. The basic assumption is that creating more diverse pools, riffles, and hiding cover will result in an increase in local fish abundance (Crawford 2004b).

Riparian Planting Projects – Include efforts to increase vegetation in the vicinity of salmon habitat. The objective of riparian planting projects is to restore natural streamside vegetation to the stream bank and riparian corridors. The assumption is that riparian vegetation increases shade to the stream, leading to cooler temperatures that are more beneficial for salmon. Riparian vegetation also reduces sedimentation, which can have negative effects on salmon habitat (Crawford 2004c).

Riparian Livestock Exclusion Projects – Include fencing to exclude livestock from riparian areas. The objective of livestock exclusion fencing is to exclude livestock from the riparian area of the stream where they can cause severe damage to stream banks and vegetation, increasing erosion and sedimentation. By excluding livestock, these adverse impacts can be avoided and restoration can occur (Crawford 2004d).

Constrained Channel Projects – Include dike removal/setback, riprap removal, road removal/setback, and landfill removal. The objective of constrained channel projects is to restore the natural flood-flow channel capacity so that gravel, large wood, normal stream morphology, and fish habitat can be restored (Crawford 2004e).

Channel Connectivity Projects – Include reconnecting side channels, off-channel habitat creation or restoration, and wetland restoration. The objective of channel connectivity projects it to restore lost channels and side channel rearing areas to active fish production and to dissipate the destructive effects of flood flows on habitat (Crawford 2004f).

Spawning Gravel Projects – Include in-stream placement of spawning gravel. The objective of gravel placement projects is to improve spawning habitat capabilities within the restoration area by placing gravel in the stream. The assumption is that in some systems spawning areas are a limiting factor in producing salmon, and placing gravel in the stream should result in increased successful spawning and local juvenile and adult fish abundance (Crawford 2004g).

In-Stream Diversion Projects – Include irrigation diversion dams, water treatment plants, pipes, ditches, headgates, and hydropower penstocks. The objective of in-stream diversion projects is to prevent passage of salmon into areas where they may be stranded or subjected to increased mortality such as irrigated fields, turbines, treatment plants, factories, and other uses of water that could be hazardous to fish survival. Salmon survival for a watershed can be improved by screening and otherwise protecting fish from diversions (Crawford 2004h).

Habitat Protection Projects – Include habitat protection at the parcel scale without further restoration actions. The goals of these projects include: 1) protect identified blocks of critical habitat for a given listed salmon species, which protects the species at risk from further decline; 2) protect property that is providing key linkages connecting fragmented habitats; and 3) protect property used to enhance existing habitat and to offset poor habitat elsewhere in the watershed (Crawford and Arnett 2004).

3. PROCEDURES COMMON TO ALL PROJECT CATEGORIES

3.1 SITE SELECTION

For each monitoring category, projects were selected randomly for monitoring from the list of all the projects funded for the 2004 grants in that category. The target number of projects to be monitored in each category was ten, for a total of 90 projects sampled during the duration of the program. Once the list of projects to be monitored was generated, project sponsors were contacted during the pre-field process.

Prior to beginning monitoring activities, preparation for the field season included acquiring permission to access all monitoring sites, obtaining sampling permits , developing a digital data collection system, and determining suitable locations for control reaches for the BACI design projects. See Appendices A and B for project location descriptions and a map of project locations.

3.2 ACCESS

Permission was obtained for each project site access from the landowner(s) before starting seasonal fieldwork. The process for gaining access permission was initiated by a letter of introduction to the project sponsor introducing the field team to the project sponsor. Access issues were prioritized so that those sites that needed to be sampled first were the initial focus (e.g., sites with near-term implementation dates, or sites that required spawner surveys that take several months).

Project sponsors also provided valuable information and assistance in determining potential control sites for BACI design projects. These reaches were often on adjacent properties and permission to access the control site over time was also gained, if possible, during this initial contact. Potential control sites were examined and it was determined in the field if they were suitable as controls.

3.3 PERMITS

Where required, state and federal permits, were obtained prior to sampling. Permits required consist of the following: 1) Scientific Collection Permit from Washington Department of Fish and Wildlife (WDFW), and 2) Endangered Species Act (ESA) incidental take permits (Section 10A 1(a)) from National Oceanic and Atmospheric Administration (NOAA) Fisheries (for waters with listed salmon and steelhead) and/or from U.S. Fish and Wildlife Service (USFWS; for waters with bull trout).

3.4 DIGITAL DATA COLLECTION

Data were recorded using Husky FEX 21® handheld computers. Electronic field forms for each monitoring task were built either in Visual CE® or Microsoft Excel® software. Field data were downloaded to field laptops and sent to a permanent centralized database. Digital files for each project include a project site map with aerial photos or orthophotos, as available, digital data collection forms for hand-held data loggers, photos of the transects in the control and impact reaches, and database structures to house the field data collected and calculate the appropriate summary statistics. These summary statistics were entered into the SRFB PRISM database used to track SRFB-funded restoration projects. With each year of monitoring, data will be added to the PRISM database to track habitat and fish response through time.

BACI Designs

Seven of the nine project types have BACI sample designs. For this sample design, control and impact reaches were established and documented. These reaches were sampled before project implementation and will be resampled for several years after project implementation. For each project site, the “X” point was located using a global positioning system (GPS) unit, and control and impact reaches were located in reference to the “X” point. For fish passage projects, the “X” site was the location of projects with a structure of interest (e.g., the fish passage barrier). For other project categories, the “X” site was the center of the sample reach. Each reach was selected in accordance with the EPA Environmental Monitoring and Assessment Program protocols as summarized in the Washington SRFB Effectiveness Monitoring Protocols (Crawford 2004 a-h, Crawford and Arnett 2004). Within each reach, 11 equally spaced sampling transects, labeled A through K, were established and flagged. Total length of the sample reach was based on 40 times the average wetted width of the channel. Permanent rebar stakes were placed at Transects A, F, and K to facilitate relocating the sample reach (Figure 3-1).

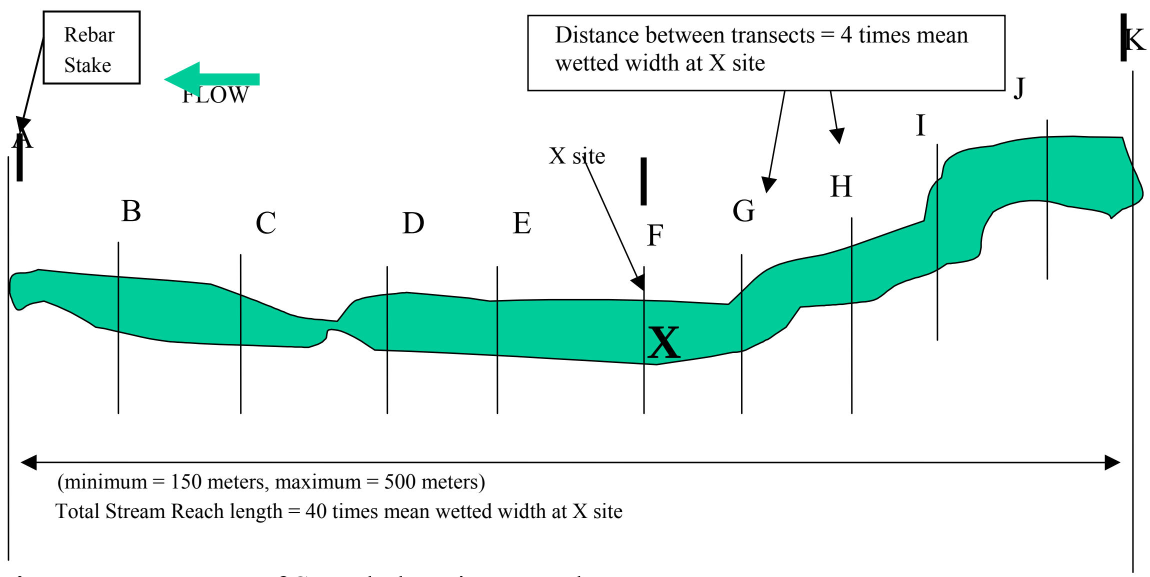


Figure 3-1. Layout of Sampled Project Reach

Transect F fell in the center of the sample reach and served as the “X” site for larger-scale project categories. GPS points were recorded for each sample reach at Transects A, F, and K where the rebar stakes were placed. Photos were taken of the view upstream and downstream at Transects A, F, and K to help relocate the transects. Additionally, a reach map was drawn for each sample reach with the location of each transect and reach-scale landmarks to help relocate the sample reach. The combination of the GPS points, rebar stakes, reach description, photos, and reach map was deemed sufficient documentation to relocate the sample reaches in subsequent sampling efforts.

4. METHODS AND RESULTS

Detailed protocols for each project category are available in Crawford (2004 a-h) and Crawford and Arnett (2004). The protocols include goals and objectives of each protocol, detailed field collection descriptions, summary statistics that will be reported, and data analysis procedures. The following sections summarize the types of monitoring done under each project category and the resulting summary statistics for each project site sampled in the 2004 field season.

The first section summarizes the methods and results for project categories that use the BACI design with a control and impact reach. The second section summarizes the methods and results from the habitat protection projects, which do not have a control. In these projects the monitoring goal is to track changes in ecological health through time.

4.1 BACI DESIGN PROJECTS

4.1.1 Fish Passage

4.1.1.1 Protocol Description

The 2004 project list included three fish passage projects. Effectiveness monitoring of fish passage projects included monitoring design specifications, juvenile salmon abundance, and spawner/redd counts. Fish passage project monitoring required a BACI design with the control reach located below, and impact reach located above the fish passage structure. Because spawner surveys were part of the monitoring activity, these reaches were selected to include appropriate spawning habitat. The “X” point for these projects was the fish passage structure itself.

Design Specifications

The Protocol for Monitoring Effectiveness of Fish Passage Projects (MC-1) (Crawford 2004a), identifies the approach for monitoring culvert function based on the species of salmonid for which the fish passage structure was designed. Because the data collected during the 2004 field season were pre-project data, design specifications are not included because these will not be measured until after the project has been implemented. Measurable design criteria from project sponsor plans will be identified once the project is implemented. Each project will be given a percent score based on the number of design features that are in compliance with the plans, as compared to the total number of design features selected for measurement. From these data, the overall percentage of measurements in compliance with design criteria will be calculated as an average of the percentages collected each year. The project will be considered to be effective if 80 percent of the design criteria are met.

After the fish passage project is built, design specifications monitoring will be conducted at the first low-flow opportunity (typically when juvenile salmon surveys are being conducted), as well as at high flows.

Juvenile Salmon Abundance

Protocol for Monitoring Effectiveness of Fish Passage Projects (MC-1) (Crawford 2004a) identifies the methods (snorkeling and electrofishing) used to assess juvenile fish abundance. Because snorkel surveys are less intrusive and destructive than electrofishing (Murphy and Willis 1996), they were used whenever appropriate. Snorkel surveys were used at all Fish Passage Project sites sampled during the 2004 field season. Surveys were generally conducted during the low-flow period in the summer.

Snorkel surveys, depending on stream size, used two to four snorkelers. Snorkelers counted all fish observed, focusing on salmonids (juvenile coho, Chinook salmon, chum salmon, and pink salmon, rainbow trout/steelhead, bull trout, and cutthroat trout). After snorkeling, the reach was ranked for turbidity using criteria described in Crawford (2004a). The reach surface area was determined using Protocol for Monitoring Effectiveness of Fish Passage Projects (MC-1) (Crawford 2004a). The length of the reach was measured and 21 stream widths were measured at even intervals along the reach. The average reach width was multiplied by the reach length to calculate surface area. For each study reach, the density of fish (fish/m^2) observed for Chinook salmon, coho salmon, rainbow trout/steelhead, and bull trout was calculated. Fish passage projects will be considered effective if there is a 20 percent increase in juvenile salmonid populations after 5 years.

Sampling for juvenile salmon abundance occurred during the low-flow period or other appropriate period for each project location. About 1 day per reach was needed to conduct this monitoring, or 2 days per project for the control and impact reaches.

Spawner and Redd Abundance

Spawner and redd surveys were conducted every 10 days in both the impact and control reaches beginning with the earliest anticipated spawning date for the target species until the end of the normal spawning period for that species (Crawford 2004a). Surveys were conducted on foot to count spawners and redds. Redd locations and carcasses were marked and, when possible, data on gender, length, and adipose fin presence were recorded for carcasses. Fish Passage Projects will be considered effective if a 20 percent increase in spawners or redds is detected after 5 years.

Up to nine trips (one every 10 days) per site were originally estimated to be needed to cover the spawning season for most target species. For the three fish passage projects sampled in 2004, eight trips adequately covered the spawning season.

4.1.1.2 Results/Data Summaries/Decision Criteria

Table 4-1 identifies the summary statistics reported for each fish passage project. As mentioned above, spawner surveys focused on target species, so only adult and redd data for the target species are reported for each project.

Table 4-1. Decision Criteria and Statistical Test Type for Fish Passage Projects

Monitoring Parameter	Indicators[1/]	Unit	Test Type	Decision Criteria
Reach Layout	Length of stream affected by project (STRMLGTH)	m	None	None
	Length of sample reach (REACHLGTH)	m	None	None
	Average width of sample reach (REACHWIDTH)	m	None	None
Passage Structure	Passage design criteria met (PASSDESIGN)	Yes/No	Count of intact structures (is this right?)	≥ 80% of projects are Yes by Year 5 ≥ 80% of each project design is intact to rate a Yes
Juvenile Fish Abundance	Chinook salmon juvenile abundance (CHINJUV)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
	Coho salmon juvenile abundance (COHOJUV)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
	Steelhead juvenile abundance (SHPARR)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
Adult Fish Abundance (Total number of spawners or redds observed over all surveys divided by the length of the sample reach in km. Only one target species was monitored for each project.)	Chinook salmon redds (CHINREDD) or Chinook salmon spawner abundance (CHINADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
	Coho salmon redds (COHOREDD) or coho salmon spawner abundance (COHOADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
	Steelhead redds (SHREDD) or coho salmon spawner abundance (SHADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
	Bull trout redds (BULLREDD) or bull trout spawner abundance (BULLADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
	Pink salmon redds (PINKREDD) or pink salmon spawner abundance (PINKADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
	Chum salmon redds (CHUMREDD) or chum salmon spawner abundance (CHUMADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5
	Sockeye salmon redds (SOCKREDD) or sockeye salmon spawner abundance (SOCKADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 5

Source: Crawford 2004a
[1/]Variable names in all caps relate to database variables discussed later in the results section.

4.1.1.3 Project-Specific Summaries

MC-1 Fish Passage

02-1530 Salmon River Tributary 21-0143 Culvert Barrier

Above: confluence of tributary with mainstem Salmon River in control reach
Below: Representative photo of tributary in impact reach

Location: Grays Harbor County, Tributary to the Salmon River.

GPS Coordinates *taken at X-site instead				
REACH	Upstream		Downstream	
Control	lat	47 31 26.8	lat	47 31 30.6
	long	124 03 10.5	long	124 03 15.6
Impact	lat*	47 33 29.2	lat	47 33 28.3
	long*	124 16 50.3	long	124 16 50.1

Objective/Intent: This project will replace a 72-inch culvert that is acting as a partial fish barrier on Watershed Resource Inventory Area (WRIA) #21-0143 tributary, 110 feet above the Middle Fork Salmon River confluence. The existing culvert has a 4.5-foot outfall drop and high velocities, creating a partial barrier to adult salmon migration and a full barrier to juvenile passage. Replacement with an adequately sized arch culvert will provide access to 0.8 miles of spawning and rearing habitat for coho salmon, steelhead, and cutthroat trout.

Summary Statistics for Pre-Installation Monitoring (Year 0):

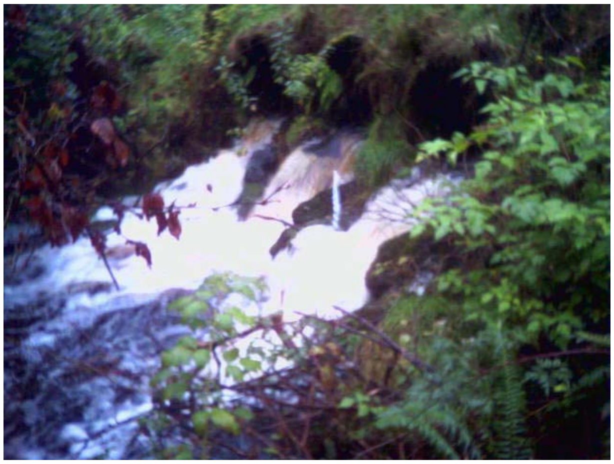
Stream Physical Characteristics		
Variable[1/]	Control	Impact
Stream Length (m)	N/A	1,287.48
Reach Length (m)	150.00	120.00
Reach Width (m)	8.00	2.82
Fish Data		
Chinook Juveniles (fish/m^2)	0.00	0.00
Coho Juveniles (fish/m^2)	0.05	0.00
Steelhead Parr (fish/m^2)	0.49	0.02
Chinook Adults (fish/km)	0.00	0.00
Chinook Redds (redds/km)	0.00	0.00
Chum Adults (fish/km)	0.00	0.00
Chum Redds (redds/km)	0.00	0.00
Coho Adults (fish/km)	8.00	0.00
Coho Redds (redds/km)	8.00	0.00
Pink Adults (fish/km)	0.00	0.00
Pink Redds (redds/km)	0.00	0.00
Steelhead Adults (fish/km)	0.00	0.00
Steelhead Redds (redds/km)	0.00	0.00
Sockeye Adults (fish/km)	0.00	0.00
Sockeye Redds (redds/km)	0.00	0.00
Fish Passage		
Passage Design (y/n)	N/A	N/A

[1/] See Table 4-1 for explanation of variables.
Data collected July 20, 2004.

Project Sponsor: Quinault Indian Nation
Contact: Joe Fitting
Landowner: Quinault Indian Nation

MC-1 Fish Passage

02-1602 Donkey Creek Culvert



Above: Downstream end of triple-barrel culvert during autumn flows

Location: Jefferson County, Donkey Creek, Tributary to the Lower Clearwater.

GPS Coordinates				
REACH	Upstream		Downstream	
Control	lat	47 33 29	lat	47 33 26.3
	long	124 16 50.6	long	124 16 52.3
Impact	lat	47 33 31.7	lat	47 31 27.7
	long	124 3 13.3	long	124 16 52.3

Objective/Intent: Replace known fish barrier culvert on Donkey Creek, opening up 1,200 square meters of spawning habitat and close to 3,000 square meters of rearing area for coho salmon, chum salmon, cutthroat trout, steelhead, and Dolly Varden/bull trout.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	**Control**	**Impact**
Stream Length (m)	N/A	0.00
Reach Length (m)	150.00	150.00
Reach Width (m)	2.08	1.93
Fish Data		
Chinook Juveniles (fish/m^2)	0.00	0.00
Coho Juveniles (fish/m^2)	0.19	0.00
Steelhead Parr (fish/m^2)	0.00	0.00
Bull Trout Adults (fish/km)	0.00	0.00
Bull Trout Redds (redds/km)	0.00	0.00
Chinook Adults (fish/km)	0.00	0.00
Chinook Redds (redds/km)	0.00	0.00
Chum Adults (fish/km)	0.00	0.00
Chum Redds (redds/km)	0.00	0.00
Coho Adults (fish/km)	0.00	0.00
Coho Redds (redds/km)	0.00	0.00
Pink Adults (fish/km)	0.00	0.00
Pink Redds (redds/km)	0.00	0.00
Steelhead Adults (fish/km)	0.00	0.00
Steelhead Redds (redds/km)	0.00	0.00
Sockeye Adults (fish/km)	0.00	0.00
Sockeye Redds (redds/km)	0.00	0.00
Fish Passage		
Passage Design (y/n)	N/A	N/A

[1/]See Table 4-1 for explanation of variables.
Data collected July 20, 2004.

Project Sponsor: Washington Department of Fish and Wildlife, Jefferson County
Contact: Dave King, Monty Rinders

MC-1 Fish Passage

02-1574 Melaney Creek Fish Passage Project

Above: Control reach looking upstream at midpoint
Below: Impact reach looking at the culvert

Location: Mason County, Melaney Creek, flows from Spencer Lake to Oakland Bay.

GPS Coordinates				
REACH		Upstream		Downstream
Control	lat	48 29 14.7	lat	48 24 13
	long	122 07 37.8	long	122 07 44.7
Impact	lat	48 29 18.7	lat	48 29 18.7
	long	122 06 56.3	long	122 07 2.9

Objective/Intent: The intent of this project is to improve the road/stream crossing at Agate Road for anadromous and resident fish by replacement of a fish-barrier culvert with a stream simulation structure that will provide additional habitat, allow for natural stream function, and improve the natural complexity of the stream. Undeveloped upstream habitat with low stream gradient, high canopy cover, mixture of gravel and fines, and stable stream flow will be made available to fish of all life history stages, including spawning adults and rearing juveniles. Removal of this culvert will provide unimpeded access for fish from productive Oakland Bay estuaries to Spencer Lake.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	**Control**	**Impact**
Stream Length (m)	N/A	4,023.36
Reach Length (m)	210.00	210.00
Reach Width (m)	3.28	2.65
Fish Data		
Chinook Juveniles (fish/m^2)	0.00	0.00
Coho Juveniles (fish/m^2)	0.01	0.00
Steelhead Parr (fish/m^2)	0.03	0.01
Chinook Adults (fish/km)	0.00	0.00
Chinook Redds (redds/km)	0.00	0.00
Chum Adults (fish/km)	0.00	0.00
Chum Redds (redds/km)	0.00	0.00
Coho Adults (fish/km)	47.62	4.76
Coho Redds (redds/km)	9.52	0.00
Pink Adults (fish/km)	0.00	0.00
Pink Redds (redds/km)	0.00	0.00
Steelhead Adults (fish/km)	0.00	0.00
Steelhead Redds (redds/km)	0.00	0.00
Sockeye Adults (fish/km)	0.00	0.00
Sockeye Redds (redds/km)	0.00	0.00
Fish Passage		
Passage Design (y/n)	N/A	N/A

[1/]See Table 4-1 for explanation of variables.
Data collected July 30, 2004.

Project Sponsor: South Puget Sound SEG
Contact: Lance Wineka, Cedar Boute
Landowner: Mason County, Rich Hirschber

4.1.2 In-Stream Structures

4.1.2.1 Protocol Description

Artificially Placed In-Stream Structures (AIS)

The 2004 project list included four AIS projects located throughout the state. Effectiveness monitoring of AIS projects includes: quantifying and measuring AIS, juvenile salmonid abundance, stream morphology, and riparian vegetation. AIS monitoring requires a BACI sample design where the impact reach includes the AIS structures, and the control reach is a representative reach generally located upstream of the AIS structures.

Quantifying AIS

The Protocol for Monitoring Effectiveness of In-Stream Habitat Projects (Crawford 2004b) provides a three-step procedure for quantifying AIS after implementation in Year 1. In 2005, the number of pieces placed will be inventoried and their location recorded using a GPS unit. If all of the pieces remain in place, the effectiveness rating is 100 percent. A project will be rated effective if at least 80 percent of AIS remain in place over 10 years. Quantification of AIS will be conducted at low flow and high flows following implementation.

Juvenile Salmonid Abundance

Juvenile salmon abundance was assessed using the same general procedures identified in 4.1.1.2. However, one AIS site was too turbid for snorkeling, so electrofishing was used for the juvenile survey. Electrofishing was conducted with the removal method (Crawford 2004b), using up to three passes with block nets in place. After each pass, fish were identified by species and measured for length. Following electrofishing, all fish were returned to the study reach after identification and enumeration.

Stream Morphology

The Protocol for Monitoring Effectiveness of In-Stream Habitat Projects (Crawford 2004b) was used to measure changes in stream morphology associated with habitat restoration projects using a Thalweg profile. The profile consisted of a longitudinal survey of depth, habitat class, fine sediment deposits, slope, and off-channel habitat at equally spaced intervals along the sample reach. Wetted width and substrate were measured at 21 transects consisting of the 11 lettered transects (A through K) and the midpoint station between each lettered transect. If a significant side channel was present, transects for the side channel were measured as well. For the substrate assessment, substrate particles were classified into the appropriate size classes by measuring the intermediate axis of the particle from five stations across the channel at each transect. AIS projects will be considered effective if there is a 20 percent improvement in mean residual vertical profile area, and mean residual depth after 10 years. Mean residual vertical profile area (Mean Residual Pool Vertical Profile Area, Table 4-2) and mean residual depth (Mean Residual Depth, Table 4-2) are measures of the amount of pool refuge and the level of pool quality provided for fish within the sample reach. Data analysis methods are discussed further in Section

5.0. Stream morphology, substrate, large woody debris, residual depth, riparian vegetation, and shading were monitored during the low-flow period.

Substrate

Protocol for Monitoring Effectiveness of In-Stream Habitat Projects (Crawford 2004b) was used to measure the change in the percentage of fines and embeddedness in control and impact reaches. Substrate was assessed during the summer low-flow period when turbidity and visibility were best. For the 21 transects established in the Thalweg profile, substrate size class was estimated for 105 particles at five equally spaced points across each transect.

Large Woody Debris

Protocol for Monitoring Effectiveness of In-Stream Habitat Projects (Crawford 2004b) was used to measure large woody debris (LWD). Pieces of LWD were counted by size class during summer low flow at the same time as other in-stream measurements. Details on size classes can be found in Crawford (2004b). Only pieces greater than 10 cm in diameter at the small end and over 1.5 m in length were included in the tally. Counts for pieces within bankfull channel and those that bridged the bankfull channel were kept separate.

Slope Measurements

Protocol for Monitoring Effectiveness of In-Stream Habitat Projects (Crawford 2004b) was the basis for measuring the water surface slope and the direction of flow that are used to calculate residual pool depth. However, in this survey, a hand level was used to measure slope because it was found to be more reliable than a rangefinder in brush and inclement weather. The upstream team member, standing at water level, sighted on a stadia rod held by the downstream team member at water level and recorded the height at which the bubble was level between each of the 21 transects identified in the reach layout and used in the Thalweg profile. The difference in the height recorded as seen through the level and the eye-level height of the observer was the "rise," and the distance between the team members was the "run" in calculating the water surface slope. It is recommended that the Protocol for Monitoring Effectiveness of In-Stream Habitat Projects (Crawford 2004b) be amended to reflect this change. The upstream team member also sighted back to the rod with a bearing compass and recorded the bearing of the stream flow in the downstream direction. If the team members could not see each other between transects, intermediate slope readings were taken. The distance over which each slope reading was taken was recorded and a weighted average slope was used in calculations.

Riparian Vegetation Structure

Protocol for Monitoring Effectiveness of In-Stream Habitat Projects (Crawford 2004b) describes the steps used to measure riparian structure. The dominant vegetation type for the canopy (deciduous, coniferous, broadleaf evergreen, mixed, or none) was determined at each lettered transect, along with the aerial cover classes of small and large trees within the canopy layer. The dominant vegetation in the understory layer was also determined at each transect and the aerial cover class was recorded for woody shrubs, saplings, seedlings, non-woody vegetation, and the amount of bare ground. Similar measurements were recorded for ground cover.

Shading

Protocol for Monitoring Effectiveness of In-Stream Habitat Projects (Crawford 2004b) was used to measure shading for riparian plantings. Measurements of canopy cover were taken at each lettered transect using a densiometer. Densiometer readings were taken at the right and left banks and in four directions in the middle of the channel. Results were averaged from the six in-stream measurements to produce the mean canopy density at each transect.

4.1.2.2 Results/Data Summaries/Decision Criteria

Table 4-2 shows the summary statistics reported for AIS projects. The location and number of in-stream structures will be recorded in 2005 when the structures have been placed.

Table 4-2. Decision Criteria and Statistical Test Type for Artificial In-Stream Structure Projects

Monitoring Parameter	Indicators [1/]	Unit	Test Type	Decision Criteria
Structure	Measure of the number of in-stream structures within the study reach (AIS)	#	None. Count of intact structures	≥ 80% of projects are intact by Year 10. Intact means that 50% of material of each Artificial Instream Structures Present is in place within the impact reach.
Stream Morphology	Mean residual pool vertical profile area (AREASUM)	m^2	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Mean residual depth (RP100)	cm	Linear regression or paired *t*-test	Alpha =0.10 for one-sided Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Large Wood (Log 10 (V1WM100)	m^3	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
Juvenile Fish Abundance	Chinook salmon juvenile abundance (CHINJUV)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Coho salmon juvenile abundance (COHOJUV)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Steelhead juvenile abundance (SHPARR)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10

Source: Crawford 2004b
[1/]Variable names in all caps relate to database variables discussed later in Section 4.1.2.3.

4.1.2.3 Project-Specific Summaries

MC-2 In-Stream Structures

02-1561 Edgewater Park Off-Channel Restoration

Above: Upstream confluence of control site side channel
Below: Dry channel at impact reach

Location: Skagit County, Edgewater Park on the Skagit River, City of Mount Vernon.

GPS Coordinates				
REACH		Upstream		Downstream
Control	lat	48 28 37.1	lat	48 23 38.2
	long	122 21 58.2	long	122 22 1.8
Impact	lat*	48 25 0.6	lat	48 24 55.2
	long*	122 20 38.1	long	122 20 44.9

Objective/Intent: Construct approximately 34 acres of restored off-channel sloughs and reconnect isolated habitat to the Skagit River. This will add to the natural river functions and increase the ability of the area to provide key protection and shelter habitat to all salmon species at various life stages.

Exceptions: Construction had not yet begun, so measurements for the impact reach were taken in a dry channel approximating the planned channel location and width. Fish surveys were not possible due to dry channels in both control and impact reaches.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	Control	Impact
Mean Residual Pool Vertical Profile Area (m^2)	0.00	0.00
Mean Residual Depth (cm)	0.00	0.00
Volume of LWD (m^3)	1.31	1.11
Stream Length (m)	NA	0.00
Reach Length (m)	110.00	110.00
Reach Width (m)	5.28	2.70
Fish Data		
Chinook Juveniles (fish/m^2)	0.00	0.00
Coho Juveniles (fish/m^2)	0.00	0.00
Steelhead Parr (fish/m^2)	0.00	0.00
In-Stream Structures		
Artificial Instream Structures Present (#)	N/A	N/A

[1/] See Table 4-2 for explanation of variables.
Data collected July 29, 2004.

Project Sponsor: City of Mount Vernon
Contact: Larry Otos, Curt Miller
Landowners: City of Mount Vernon, Park and Recreation Department, Washington Department of Fish and Wildlife (control reach)

MC-2 In-Stream Structures

02-1444R Little Skookum Valley, Phase II Riparian

View of Little Skookum Creek from the left bank looking upstream

Location: Mason County, Mason Conservation District.

GPS Coordinates				
REACH		Upstream		Downstream
Control	lat	47 06 34.5	lat	47 06 35.4
	long	123 07 17.6	long	123 07 23.3
Impact	lat	47 06 35.4	lat	47 06 35.6
	long	123 07 26.5	long	123 07 31.3

Objective/Intent: Due to past human activities, the riparian area along this section of creek lacks riparian cover and large woody debris in stream. There is also excessive invasive plant cover (reed canary grass) along the banks. This project aims to improve stream habitat of Little Skookum Valley Creek for salmonids and other species by installation of large woody debris, riparian fencing, and riparian plantings.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable [1/]	**Control**	**Impact**
Mean Residual Pool Vertical Profile Area (m^2)	19.50	7.60
Mean Residual Depth (cm)	13.00	5.10
Volume of LWD (m^3)	-1.40	0.00
Stream Length (m)	N/A	450.00
Reach Length (m)	150.00	150.00
Reach Width (m)	1.35	1.29
Fish Data		
Chinook Juveniles (fish/ m^2)	0.00	0.00
Coho Juveniles (fish/ m^2)	0.00	0.09
Steelhead Parr (fish/ m^2)	0.00	0.00
In-Stream Structures		
Artificial Instream Structures Present (#)	N/A	N/A

[1/] See Table 4-2 for explanation of variables.
Data collected June 30, 2004.

Project Sponsor: South Puget Sound SEG
Contact: Lance Wineka
Landowner: Rich Hirschberg

MC-2 In-Stream Structures

02-1463R Salmon Creek

Above: Impact Reach Transect F looking upstream
Below: Impact Reach Transect F looking downstream

Location: This project is located in Pacific County within the Naselle River Basin (WRIA 24) on Salmon Creek. The sampling reaches are located on Salmon Creek within Township 11N Range 8W Southeast corner of Section 23 (Impact Reach) and Section 13 (Control Reach). The midpoint of the impact reach is at 46^{o} 24' 51.97820" N; 123^{o} 37' 29.02656" W. The control reach is located approximately 1.9 miles upstream from the impact reach with the midpoint at 46^{o} 26' 14.11001" N; 123^{o} 36' 31.60073" W.

GPS Coordinates				
REACH		Upstream		Downstream
Control	lat	46 26 16.4	lat	46 26 11.6
	long	123 36 30.2	long	123 36 33.0
Impact	lat	46 24 54.0	lat	46 24 49.3
	long	123 37 27.4	long	123 37 28.3

Objective/Intent: In conjunction with road decommissioning activities, this project will result in the placement of large woody debris throughout approximately 5,000 linear feet of Salmon Creek to improve habitat for cutthroat trout, steelhead, coho salmon, Chinook salmon, and chum salmon.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable [1/]	**Control**	**Impact**
Mean Residual Pool Vertical Profile Area (m^2)	12.33	18.03
Mean Residual Depth (cm)	6.85	10.02
Volume of LWD (m^3)	1.16	0.52
Stream Length (m)	N/A	1,609.34
Reach Length (m)	180.00	180.00
Reach Width (m)	3.01	5.49
Fish Data		
Chinook Juveniles (fish/m^2)	0.00	0.01
Coho Juveniles (fish/m^2)	0.18	0.60
Steelhead Parr (fish/m^2)	0.00	0.00
In-stream Structures		
Artificial In-stream Structures Present (#)	N/A	N/A

[1/]See Table 4-2 for explanation of variables.
Data collected June 8, 2004 through June 10, 2004.

Project Sponsor: Willapa Bay Fisheries Enhancement Group
Contact: Ron Craig
Landowners: The Campbell Group and the Washington Department of Natural Resources

MC-2 In-Stream Structures

02-1515 Upper Trout Creek Restoration

Above: Impact Reach Transect F looking upstream
Below: Impact Reach Transect F looking downstream

Location: The project area is located in Skamania County within the Wind River Basin (WRIA 29) in the Trout Creek drainage. The sampling reaches are located on Crater Creek (tributary to Trout Creek) within Township 4N Range 6E Section 11 (Impact Reach) and Section 3 (Control Reach). The midpoint coordinates for the impact reach are 45^o 50' 47.99317" N; 122^o 2' 10.97501" W. The control reach is located approximately 1.4 miles upstream from the impact reach with the midpoint at 45^o 51' 20.39430" N; 122^o 3' 36.79222" W.

GPS Coordinates				
REACH	Upstream		Downstream	
Control	lat	46 26 16.4	lat	46 26 11.6
	long	123 36 30.2	long	123 36 33.0
Impact	lat	46 24 54.0	lat	46 24 49.3
	long	123 37 27.4	long	123 37 28.3

Objective/Intent: The Upper Trout Creek Rehabilitation Project serves to improve habitat for wild steelhead by restoring riparian areas and channel stability in the Trout Creek drainage. Chinook salmon and cutthroat trout may benefit from this project as well.

Specific objectives are to: 1) restore riparian conifers along Upper Trout, Crater, Compass and Layout Creeks to eight trees/acre > 31" diameter (200 years), 2) increase shade >80% (60 years), 3) increase bank stability >80% (2 years), 4) reduce bankfull width to depth ratios <25 (2 years), and 5) increase large woody debris to greater than 100 pieces/ river mile (1 year).

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	Control	Impact
Mean Residual Pool Vertical Profile Area (m^2)	15.43	19.95
Mean Residual Depth (cm)	10.29	13.30
Volume of LWD (m^3)	1.95	1.68
Stream Length (m)	N/A	487.68
Reach Length (m)	150	150
Reach Width (m)	3.39	4.28
Fish Data		
Chinook Juveniles (fish/m^2)	0.00	0.00
Coho Juveniles (fish/m^2)	0.00	0.00
Steelhead Parr (fish/m^2)	0.00	0.0046
In-stream Structure		
Artificial In-stream Structures Present (#)	N/A	N/A

[1/] See Table 4-2 for explanation of variables.
Data collected July 13, 2004 and July 14, 2004.

Project Sponsor: Underwood Conservation District
Contacts: Steve Stampfli, Brian Bair
Landowner: United States Forest Service

4.1.3 Riparian Plantings

4.1.3.1 Protocol Description

The 2004 project list identified four riparian plantings located throughout the state. Monitoring for riparian plantings includes measuring riparian vegetation structure and shading pre-project implementation, and adding monitoring of planting survival after project implementation.

Quantifying Riparian Plantings

Protocol for Monitoring Effectiveness of Riparian Planting Projects (Crawford 2004c) describes the methods for measuring the survival of riparian plantings. This quantification will take place in the 2005 field season after implementation for 2004 projects. For areas 1 to 2 acres or less, a complete census of plantings will be conducted after implementation. If the planting is larger, 10 random points will be selected within the planting area and circular plots will be sampled. The center point of each plot will be marked and data collected will be used to calculate average plant density per acre. Survival will be measured and the project considered effective if 50 percent survival is achieved.

Riparian Vegetation Structure

Riparian vegetation structure was monitored using the same protocols described in Section 4.1.2.1.

Shading

Shading was quantified using the same protocols described in Section 4.1.2.1.

4.1.3.2 Results/Data Summaries/Decision Criteria

Table 4-3 identifies the summary statistics used to evaluate riparian planting projects. Survival of plantings will be measured after project implementation.

Table 4-3. Decision Criteria for Riparian Plantings

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Plantings	The number of planted plants remaining in the impact area (PLANTINGS)	#	None. Count of live plantings	≥ 50% of plantings are living by Year 10
Riparian Condition	Mean percent canopy density at the bank by densitometer reading (XCDENBK)	1-17 score	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 10
	Three-layer riparian vegetation presence (proportion of reach) (XPCMG)	%	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 10

Table 4-3. Decision Criteria for Riparian Plantings (continued)

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Riparian Condition (continued)	Actively eroding banks (BANK)	%	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 10
	Riparian area (RIPAREA)	m^2	None. measure of riparian area planted	One-time measurement of area planted

Source: Crawford 2004c
[1/] Variable names in all caps relate to database variables discussed later in Section 4.1.3.3.

4.1.3.3 Project-Specific Summaries

MC-3 Riparian Plantings

02-1561 Edgewater Park Off-Channel Restoration

Above: Dry channel at impact reach
Below: Upstream confluence of control site side channel

Location: Skagit County; City of Mount Vernon. Edgewater Park on the Skagit River.

GPS Coordinates				
REACH		Upstream		Downstream
Control	lat	48 28 37.1	lat	48 23 38.2
	long	122 21 58.2	long	122 22 1.8
Impact	lat*	48 25 0.6	lat	48 24 55.2
	long*	122 20 38.1	long	122 20 44.9

Objective/Intent: The objective of this project is to construct approximately 34 acres of restored off-channel sloughs and reconnect isolated habitat to the Skagit River. This will add to the natural river functions and increase the ability of the area to provide key protection and shelter habitat to all salmon species at various life stages.

Exceptions: Construction had not yet begun, so measurements for the impact reach were taken in a dry channel approximating the planned channel location and widths.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	Control	Impact
Stream Length (m)	NA	0.00
Reach Length (m)	110.00	110.00
Reach Width (m)	5.28	2.70
Riparian Characteristics		
Canopy Density (1-17)	16.58	16.68
Riparian Vegetation Structure (%)	18.00	27.00
Bank Erosion (%)	0.00	0.00
Riparian Planting		
Number of Plantings Remaining (#)	N/A	0.00
Area Planted (m^2)	N/A	0.00

[1/]See Table 4-3 for explanation of variables.
Data collected July 29, 2004.

Project Sponsor: City of Mount Vernon
Contact: Larry Otos, Curt Miller
Landowners: City of Mount Vernon, Parks and Recreation Department, Washington Department of Fish and Wildlife (control reach)

MC-3 Riparian Plantings

02-1446R Centralia Riparian Restoration Project

Above: View north along impact reach
Below: View downstream along impact reach

Location: Lewis County, east bank of the upper Chehalis River mainstem. The project is located on the grounds of Centralia's new wastewater treatment plant.

REACH	Upstream		Downstream	
Control	lat	46 45 7.5	lat	46 45 2.4
	long	123 1 44.6	long	123 1 43.9
Impact	lat	46 45 46.3	lat	46 45 42.1
	long	123 1 47.8	long	123 1 45.0

Objective/Intent: Salmon spawn and overwinter within the project reach of the Chehalis River. Bull trout, coho salmon, chum salmon, steelhead, and cutthroat trout migrate through as well. A riparian zone 200 feet broad and 1 mile long will be restored from agricultural field to mature forest. An existing off-channel rearing area will be enhanced through planting of local willows. These plantings will lessen bank erosion, and provide shade, cover, and microhabitats. Large woody debris recruitment will also increase as a result of this project.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable [1/]	**Control**	**Impact**
Stream Length (m)	N/A	1,609.34
Reach Length (m)	150.00	150.00
Reach Width (m)	17.00	25.00
Riparian Characteristics		
Canopy Density (1-17)	2.17	0.79
Riparian Vegetation Structure (%)	82.00	0.00
Bank Erosion (%)	0.00	50.00
Riparian Plantings		
Number of Plantings Remaining (#)	N/A	0.00
Area Planted (m^2)	N/A	0.00

[1/]See Table 4-3 for explanation of variables.
Data collected October 5, 2004.

Project Sponsor: City of Centralia
Contact: Richard Southworth
Landowner: City of Centralia

02-1616R Vandersar Restoration Project

Above: Sampling at control site on Ross Island Slough

Location: Skagit County, Middle Skagit River, near west end of Ross Island Slough.

GPS Coordinates (for riparian planting)				
REACH		Upstream		Downstream
Control	lat	8 29 29.1	lat	48 29 26.8
	long	122 .7 33.9	long	122 07 30.8
Impact	lat	48 29 19.6	lat	48 29 15.1
	long	122 07 30.9	long	122 07 34.9

Objective/Intent: Remove invasive plants and revegetate with natives both along Anderson slough and Ross Island Slough. This would add to the mostly protected natural condition of most of Ross Island Slough.

Exceptions: A small raft was used for some depths and some substrates were approximated.

Summary Statistics for Pre-Installation Monitoring (Year 0)

Stream Physical Characteristics		
Variable [1/]	Control	Impact
Reach Length (m)	180.00	180.00
Reach Width (m)	18.72	16.89
Riparian Characteristics		
Stream Length (m)	N/A	0.00
Canopy Density (1-17)	9.55	11.56
Riparian Vegetation Structure (%)	27.00	27.00
Bank Erosion (%)	57.75	100.00
Riparian Plantings		
Number of Plantings Remaining (#)	N/A	0.00
Area Planted (m^2)	N/A	0.00

[1/] See Table 4-3 for explanation of variables.
Data collected May 18, 2004.

Project Sponsor: Seattle City Light
Contact: Edward Connor
Landowner: Carl Vandersar, downstream landowner; Liane Rusnak, upstream landowner

MC-3 Riparian Plantings

02-1623 Snohomish River Confluence Reach Restoration

Above: Impact reach, looking southeast

Location: Snohomish County, south of city of Snohomish and west of Monroe.

GPS Coordinates *taken at X-site instead				
REACH	Upstream		Downstream	
Control	lat	47 51 42.3	lat	47 51 39.4
	long	122 05 15.6	long	122 05 19.5
Impact	lat*	47 50 4.5	lat	47 50 2.9
	long*	122 03 0.1	long	122 02 54.2

Objective/Intent: This project is a reach-scale restoration effort on 3 miles of important spawning, rearing, migration, and holding habitat for Chinook salmon and other salmonids on the Snohomish River. Restoration will be based on a comprehensive reach-scale analysis already completed by Snohomish County. Restoration will include riparian planting, bank restoration, large woody debris placement, reconnection of off-channel areas, and breach design at two dike sites.

Summary Statistics for Pre-Installation Monitoring (Year 0):

[1/]See Table 4-3 for explanation of variables.

Stream Physical Characteristics		
Variable [1/]	Control	Impact
Stream Length (m)	N/A	4,828.03
Reach Length (m)	150.00	150.00
Reach Width (m)	7.00	3.00
Riparian Characteristics		
Canopy Density (1-17)	0.00	0.00
Riparian Vegetation Structure (%)	0.00	0.00
Bank Erosion (%)	0.00	0.00
Riparian Plantings		
Number of Plantings Remaining (#)	N/A	0.00
Area Planted (m^2)	N/A	0.00

[1/]See Table 4-3 for explanation of variables.
Data collected October 5, 2004.

Project Sponsor: Snohomish County
Contact: Robert Aldrich
Landowner: Snohomish County Parks

4.1.4 Livestock Exclusion

4.1.4.1 Protocol Description

Livestock Exclusions

One livestock exclusion project was identified in the 2004 project list. Monitoring data collected at this site included livestock presence, shading, riparian vegetation structure, and bank erosion in control and impact reaches. Livestock presence was assessed before project implementation and presence or absence of livestock will be documented after project implementation.

Livestock Presence

The Protocol for Monitoring Effectiveness of Riparian Livestock Exclusion Projects (Crawford 2004d) was used to assess livestock presence before the exclusion was implemented, and this monitoring will be repeated after implementation. Photographs were taken to document any effects from or evidence of livestock and to try to determine the point of entry for any livestock. Livestock exclusions will be considered effective if 80 percent of the projects continue to exclude livestock after 10 years. Any entrance of livestock into the riparian area would constitute lack of project success. Data analysis methods are discussed further in Section 5.0.

Riparian Vegetation

Riparian vegetation structure will be monitored using the same approach as described in Section 4.1.2.1.

Shading

Shading will be monitored using the same approach as described in Section 4.1.2.1.

Actively Eroding Stream Banks

The Protocol for Monitoring Effectiveness of Riparian Livestock Exclusion Projects (Crawford 2004d) was used to estimate the percent of the linear distance of the channel on both sides at each transect that is actively eroding at active channel height. The project will be considered effective if a 20 percent reduction in percent bank length that is actively eroding is observed within 10 years.

4.1.4.2 Results/Data Summaries/Decision Criteria

Table 4-4 identifies the summary statistics for livestock exclusions. The determination on functional exclusions will be made after implementation.

Table 4-4. Decision Criteria for Livestock Exclusions

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Livestock Exclusion Fencing	The number of livestock exclusions meeting the design criteria for excluding livestock from the stream (EXCLDESIGN)	#	None. Count of functional exclusions	≥ 80% of exclusions are functional by Year 10. "Functional" means there are no holes in the fencing and no recent signs of livestock inside the exclusion.
Riparian Condition	Mean percent canopy density at the bank Densitometer Reading (XCDENBK)	1-17 score	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 10
	Three-layer riparian vegetation presence (proportion of reach) (XPCMG)	%	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between impact and control by Year 10
	Actively eroding banks (BANK)	%	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between Impact and control by Year 10

Source: Crawford 2004d

[1/] Variable names in all caps relate to database variables discussed later in Section 4.1.4.3.

4.1.4.3 Project-Specific Summaries

MC-4 Livestock Exclusion Projects

02-1498 Abernathy Creek Riparian Restoration

Above: Impact Reach Transect F looking upstream
Below: Impact Reach Transect F looking downstream

Location: The project area is located in Cowlitz County within Abernathy Creek (WRIA 25). The impact reach is located on the Davis property within Township 8N Range 4W Section 2. The control reach is located 1.3 miles upstream from the impact reach on USFWS property adjacent to the Abernathy Fish Technology Center at Township 9N Range 4W Sections 26 and 35.

GPS Coordinates				
REACH		Upstream		Downstream
Control	lat	46 13 35.2	lat	46 13 41.8
	long	123 8 51.5	long	123 8 55.0
Impact	lat	46 12 36.9	lat	46 12 43.1
	long	123 9 3.4	long	123 8 57.3

Objective/Intent: This project seeks to restore 85 acres (2.5 miles of shoreline) of riparian habitat along Abernathy Creek. The project begins at the highly disturbed mouth of the creek (on WDFW property) and continues through conservation easements purchased by Cowlitz County, situated below the USFWS Abernathy Technical Center. Abernathy Creek, a tributary to the Lower Columbia River, provides critical spawning and rearing habitat for Chinook, chum, and coho salmon; steelhead; and sea-run cutthroat trout. The creek has excessive sediments and low levels of large woody debris, and water temperatures exceed state standards. These conditions can be greatly improved by restoring riparian vegetation, fencing out livestock, and restricting vehicle access at the mouth of the creek.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	**Control**	**Impact**
Stream Length (m)	N/A	4,023.36
Reach Length (m)	120	120
Riparian Characteristics		
Canopy Density (1-17)	16.18	13.88
Riparian Vegetation Structure (%)	73	91
Bank Erosion (%)	2	2
Livestock Exclusions		
Exclusion Design (y/n)	N/A	N/A
Area of Exclusion (acres)	N/A	84.00

[1/] See Table 4-4 for explanation of variables.
Data collected June 11, 2004 and June 12, 2004.

Project Sponsor: Cowlitz County
Contact: Kathleen Robson, Darin Houpt
Landowners: Washington Department of Fish and Wildlife, Cowlitz County, Bob and Gail Davis, Terry and Vicki Golden, Robert Strom, James Mitchell, Jeffery Veys, Mark and Janine Robben.

4.1.5 Constrained Channels

There was one constrained channel project sampled during the 2004 field season. This project was located on a large river. The Protocol for Monitoring Effectiveness of Constrained Channels (Crawford 2004e) was designed for monitoring physical habitat on wadable streams, so these protocols could not be implemented exactly as written. Constrained channel projects are likely to occur on larger rivers, so that generally a wadable stream protocol (Crawford 2004e) is not appropriate. It is recommended that this protocol be adapted to include methods that can be used from a boat.

4.1.5.1 Protocol Description

Stream Morphology

Differences from the stream morphology procedures described in Section 4.1.2.1 are identified below. A motorboat with a depth finder was used to collect depth information at each transect. Twenty evenly spaced depths were recorded along the sample reach (versus 100 as described in Crawford 2004e), and the summary statistics were calculated from these depths. Widths were taken using a laser rangefinder at the same 21 transects described in Section 4.1.2.1.

Slope Measurements

Slope data were collected along the water's edge using similar methods as those described in Section 4.1.2.1. When the downstream team member could not be seen at the next transect, interim slope measurements were taken. The project location sampled in the 2004 field season has very low gradient and many of the slope calculations were very close to zero.

Bankfull Channel Capacity

Bankfull channel capacity was calculated using the height of the bank or constraining feature at bankfull height at each transect. For the project site sampled in 2005, the height of the bank was very consistent along the sample reach, and the levy was set back beyond the bank. The channel capacity was calculated by adding the average depth to the bankfull height and multiplying by the average bankfull width.

4.1.5.2 Results/Data Summaries/Decision Criteria

Table 4-5 identifies the summary statistics for constrained channels. As the constraints are removed, the bankfull cross-sectional area will be remeasured.

Table 4-5. Decision Criteria for Testing Constrained Channels

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Channel Conditions	Mean bankfull cross-sectional area taken from mean bankfull width and height (CHANL)	Ave. m^2	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Effective if it does not detect a 20% or greater change between Year 0 and Year 10.
	Mean residual pool vertical profile area (AREASUM)	m^2	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Mean residual depth (RP100)	cm	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between Base Year 0 and Year 10

Source: Crawford 2004e

[1/] Variable names in all caps relate to database variables discussed later in Section 4.1.5.3.

4.1.5.3 Project-Specific Summaries

MC-5 Constrained Channels

02-1625 South Fork Skagit Levee Setback and Acquisition

Above: Impact reach with levee behind
Below: Control reach looking upstream

Location: Lower Skagit River, Skagit County.

GPS Coordinates (for channel connectivity)				
REACH		Upstream		Downstream
Control	lat	48 21 42.3	lat	48 21 26.8
	long	122 21 23.4	long	122 21 24.3
Impact	lat	48 21 19.4	lat	48 21 5.3
	long	122 21 33.1	long	122 21 35.6

Objective/Intent: The objective of this project is to complete the acquisition and restoration of 37 miles of mainstem habitat along the lower Skagit River by removing 2,500 feet of existing levee and setting it back adjacent to the county road. This will restore access to off-channel wetland habitat and high-flow channels to benefit five salmon and two trout species.

Exceptions: A motorboat and depth-finder were used to approximate depths. Substrate data could not be gathered, nor could the presence of submerged logs be recordered.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	**Control**	**Impact**
Height of Constraining Structure at Bankfull Width (m)	2.69	3.05
Bankfull Width (m)	175.00	144.27
Mean Residual Pool Vertical Profile Area (m^2)	215.95	754.70
Mean Residual Depth (cm)	43.19	143.75
Reach Length (m)	500.00	500.00
Stream Length (m)	N/A	0.00
Channel Constraint		
Mean Bankfull Cross-Sectional Area (m^2)	470.31	439.73
Channel Constraint Removed (y/n)	N/A	no

[1/]See Table 4-5 for explanation of variables.
Data collected July 7, 2004.

Project Sponsor: Skagit County Dike District #3
Contact: Dave Olson
Landowners: Skagit County Dike District #3, and Betty Glascock

4.1.6 Channel Connectivity

Two channel connectivity projects were sampled during the 2004 field season. Monitoring for these projects includes channel connection status, stream morphology, residual depth, shading, vegetation structure, and juvenile salmonid abundance. One site did not have water in the channel, and the channel was poorly formed. Field data were collected where possible at this site, but juvenile fish abundance was not collected.

4.1.6.1 Protocol Description

Channel Connectivity

The Protocol for Monitoring Effectiveness of Channel Connectivity, Off-Channel Habitat, and Wetland Restoration Projects (Crawford 2004f) was used to assess channel connectivity. After implementation in 2005, we will calculate the cross-sectional area of the channel connection using the bankfull width and bankfull depth of the opening. Projects will be considered effective if 80 percent remain connected after 10 years. Data analysis is discussed further in Section 5.0.

Stream Morphology

Stream morphology monitoring was conducted as described in Section 4.1.2.1. For the project without water, no depths were taken and widths were bankfull widths. Some summary statistics for this project were zero, as all the depths were zero.

Slope Measurements

Slope measurements were taken as described in Section 4.1.2.1, except for at the project site without water. At this site, a general gradient along the edge of the old channel was measured.

Riparian Vegetation Structure

Riparian vegetation structure was monitored as in Section 4.1.2.1.

Shading

Shading was monitored as in Section 4.1.2.1.

Juvenile Salmon

Juvenile salmon abundance was monitored as in Section 4.1.1.1. Seasons for sampling were adjusted to collect data on the target species of juveniles when they were most likely to be present in the off-channel habitat. For example, Site 02-1616, Vandersar Restoration was sampled in May to try to observe juvenile Chinook salmon before they migrated to the ocean. Each site may have a different sampling time based on the species and conditions at the site and the intended season of use of the off-channel habitat by juvenile fish. Some channel connectivity locations are intended to provide over-wintering or high-water habitat for juvenile fish.

4.1.6.2 Results/Data Summaries/Decision Criteria

Table 4-6 identifies summary statistics for channel connectivity projects. Channel connection status will be monitored after implementation.

Table 4-6. Decision Criteria and Statistical Test Type for Channel Connectivity Projects

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Level 1 Channel Modification	Measure of whether the channel has remained connected to the stream per design (CHANLCONN)	Yes/No	None. Count of functional channel reconnections	≥ 80% of projects are intact by Year 5. Intact if there is present any visible flow through the channel during moderate flows.
Level 2 Stream Morphology	Mean residual pool vertical profile area (AREASUM)	m^2	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 5
	Mean residual depth (RP100)	cm	Linear regression or paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 5
Level 2 Riparian Habitat	Mean percent shading at the bank (using a densitometer) (XCDENBK)	%	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 5
	Proportion of the reach containing all three layers of riparian vegetation, canopy cover, understory, and ground cover (XPCMG)	%	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 5
Level 3 Juvenile Fish Abundance	Chinook salmon juvenile abundance (CHINJUV)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 5
	Coho salmon juvenile abundance (COHOJUV)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 5
	Steelhead juvenile abundance (SHPARR)	$\#/m^2$	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 5

Source: Crawford 2004f

[1/] Variable names in all caps relate to database variables discussed later in Section 4.1.6.3.

4.1.6.3 Project-Specific Summaries

MC-6 Channel Connectivity

02-1561 Edgewater Park Off-Channel Restoration

Above: Dry paleo-channel at impact reach
Below: Upstream confluence of control site side channel

Location: Skagit County, Edgewater Park on the Skagit River, City of Mount Vernon.

GPS Coordinates				
REACH		Upstream		Downstream
Control	lat	48 28 37.1	lat	48 23 38.2
	long	122 21 58.2	long	122 22 1.8
Impact	lat*	48 25 0.6	lat	48 24 55.2
	long*	122 20 38.1	long	122 20 44.9

Objective/Intent: The objective of this project is to construct approximately 34 acres of restored off-channel sloughs and reconnect isolated habitat to the Skagit River. This will add to the natural river functions and increase the ability of the area to provide key protection and shelter habitat to all salmon species at various life stages

Exceptions: Construction had not yet begun, so measurements for the impact reach were taken in a dry channel approximating the planned channel location and width. Fish surveys were not possible due to dry channels in both control and impact reaches.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	**Control**	**Impact**
Mean Residual Pool Vertical Profile Area (m^2)	0.00	0.00
Mean Residual Depth (cm)	0.00	0.00
Stream Length (m)	NA	1,609.34
Reach Length (m)	110.00	110.00
Reach Width (m)	5.28	2.7m
Riparian Characteristics		
Canopy Density (1-17)	16.58	16.68
Riparian Vegetation Structure (%)	18.00	27.00
Fish Data		
Chinook Juveniles (fish/m^2)	0.00	0.00
Coho Juveniles (fish/m^2)	0.00	0.00
Steelhead Parr (fish/m^2)	0.00	0.00
Channel Connectivity		
Channel Connected (y/n)	N/A	no

[1/]See Table 4-6 for explanation of variables.
Data collected July 29, 2004.

Project Sponsor: City of Mount Vernon
Contact: Larry Otos, Curt Miller
Landowner(s): City of Mount Vernon, Parks and Recreation Department, Washington Department of Fish and Wildlife (control reach)

MC-6 Channel Connectivity

02-1616 Vandersar Restoration

Above: Sampling at control site on Ross Island Slough
Below: Looking downstream from the bottom of impact site

Location: Skagit County, Middle Skagit River, near west end of Ross Island Slough.

GPS Coordinates (for channel connectivity)				
REACH		Upstream		Downstream
Control	lat	48 29 14.7	lat	48 24 13
	long	122 07 37.8	long	122 07 44.7
Impact	lat	48 29 18.7	lat	48 29 18.7
	long	122 06 56.3	long	122 07 2.9

Objective/Intent: Replace existing road crossings of oxbow and isolated slough with bridges, restoring access to Ross Island Slough, and thus providing additional spawning and rearing habitat to Chinook salmon, coho salmon, and steelhead as well as foraging habitat for migrating bull trout.

Exceptions: A small raft was used for some depths and some substrates were approximated. Reed canary grass created thick mats in some places, making it difficult to confidently determine the bottom of the impact reach. Snorkel surveys were not done on the impact reach, but juvenile coho salmon were seen below the road crossing.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics		
Variable[1/]	**Control**	**Impact**
Mean Residual Pool Vertical Profile Area (m^2)	166.07	69.39
Mean Residual Depth (cm)	92.26	38.55
Reach Length (m)	180.00	180.00
Reach Width (m)	18.20	16.90
Stream Length (m)	N/A	304.80
Riparian Characteristics		
Canopy Density (1-17)	8.02	9.20
Riparian Vegetation Structure (%)	18.00	18.00
Fish Data		
Chinook Juveniles (fish/ m^2)	0.00	0.00
Coho Juveniles (fish/ m^2)	0.05	0.00
Steelhead Parr (fish/ m^2)	0.00	0.00
Channel Connectivity		
Channel Connected (y/n)	N/A	no

[1/]See Table 4-6 for explanation of variables.
Data collected May 18, 2004.

Project Sponsor: Seattle City Light
Contact: Edward Connor
Landowners: Carl Vandersar, impact site, Liane Rusnak, control site

4.1.7 Spawning Gravel Projects

4.1.7.1 Protocol Description

Gravel Present After Placement

The Protocol for Monitoring Effectiveness of Spawning Gravel Projects will be used to assess the success of gravel placement projects. No projects in this category were identified for monitoring in the 2004 field season. For future selected projects, prior to gravel placement, the boundaries of the control and impact areas will be designated and gravel within these areas will be measured. Spawner surveys will also be conducted in control and impact reaches. After gravel placement, the total area in acres of new gravel will be determined and spawner surveys also will be conducted. Spawning gravel projects will be considered effective if a 20 percent improvement is detected in each parameter: embeddedness, fines, and number of redds and spawners. Also, to be considered effective requires that 80 percent of gravel placed remains in place over a 10-year timeframe.

Substrate

Substrate monitoring will be conducted as in Section 4.1.2.1.

Spawner and Redd Abundance

Spawner and redd abundance monitoring will be conducted as in Section 4.1.1.1.

4.1.7.2 Decision Criteria

Table 4-7 shows the summary statistics and decision criteria that are used to evaluate spawning gravel projects. Spawner and redd surveys would be limited to a single target species for each project identified.

Table 4-7. Decision Criteria and Statistical Test Type for Spawning Gravel Projects

Monitoring Parameter	Indicators[1/]	Unit	Test Type	Decision Criteria
Gravel Placement	Measure of gravel present after placement (GRAVAREA)	m^2	Count of acres of gravel remaining	≥ 50% of gravel area is remaining by Year 10
In-Stream Habitat	Mean percent of the study substrate in fines (PCT_FN)	%	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year10
	Mean percentage of the substrate that is embedded within the study reach (XEMBED)	%	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10

Table 4-7. Decision Criteria and Statistical Test Type for Spawning Gravel Projects (continued)

Monitoring Parameter	Indicators[1/]	Unit	Test Type	Decision Criteria
Adult Fish Abundance (Note: Only one target species will be monitored for abundance)	Chinook salmon redds (CHINREDD) or Chinook spawner abundance (CHINADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Coho salmon redds (COHOREDD) or coho spawner abundance (COHOADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Steelhead redds (SHREDD) or coho salmon spawner abundance (SHADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Bull trout redds (BULLREDD) or bull trout spawner abundance (BULLADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Pink salmon redds (PINKREDD) or pink salmon spawner abundance (PINKADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Chum salmon redds (CHUMREDD) or chum salmon spawner abundance (CHUMADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10
	Sockeye salmon redds (SOCKREDD) or sockeye salmon spawner abundance (SOCKADULT)	#/km	BACI paired *t*-test	Alpha =0.10 for one-sided test. Detect a minimum 20% change between treatment and control by Year 10

Source: Crawford 2004g
[1/] Variable names in all caps relate to database variables.

4.1.7.3 Project-Specific Summaries

During the 2004 field season, no spawning gravel projects were available for monitoring.

4.1.8 In-Stream Diversion Projects

Four in-stream diversion projects were identified for monitoring during the 2004 field season. However, no projects were implemented during the season, so the monitoring for these projects will occur in 2005.

4.1.8.1 Protocol Description

Diversion Screening

The Protocol for Monitoring Effectiveness of In-Stream Diversion Projects (Crawford 2004h) will be used to assess compliance with design specifications. From the engineering drawings or blueprints, measurable criteria will be identified as a means of monitoring the design specifications of diversion screening projects. The number of criteria will determine how many of these criteria need to be met to achieve 80 percent compliance. After implementation, criteria will be measured to determine if they comply with the design. The diversion screening project will be deemed effective if 80 percent of the design specifications are met.

4.1.8.2 Results/Data Summaries/Decision Criteria

Table 4-8 identifies the summary statistics for diversion screening projects.

Table 4-8. Decision Criteria for Testing Diversion Screening

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Screen Characteristics	Measure of whether the screen diversion meets design criteria (SCRNDESIGN)	%	None. Count of functional screen diversions.	≥ 80% of projects are intact by Year 5. Intact means that 80% or more of the design criteria are met at inspection.

Source: Crawford (2004h)
[1/] Variable names in all caps relate to database variables.

4.1.8.3 Project-Specific Summaries

During the 2004 field season, no diversion screening projects were available for monitoring.

4.2 HABITAT PROTECTION PROJECTS

4.2.1 Protocol Description

4.2.1.1 Freshwater Habitat Protection Projects

Seven freshwater acquisition projects were monitored during the 2004 field season. Monitoring for these projects included stream morphology, fish and macroinvertebrate assemblages, riparian vegetation, and upland vegetation. Details on the protocol used are found in Protocol for Monitoring Effectiveness of Habitat Protection Projects (Crawford and Arnett 2004). Success determination for acquisitions will be based on the number of indicators that show a significant increase over time. Because there will only be one year of data collected under this contract, trend detection will not be possible. However, Section 5.0 includes a discussion of potential methods to use to detect a trend once multiple years of data have been collected. Other data analysis methods such as regression are also described further in Section 5.0.

Stream Morphology

Stream morphology was monitored using the same procedures in Section 4.1.2.1.

Substrate

Substrate was monitored using the same protocols as described in Section 4.1.2.1.

Large Woody Debris

Large woody debris was monitored using the same protocols as described in Section 4.1.2.1.

Slope Measurements

Slope was measured using the same protocols as described in Section 4.1.2.1.

Riparian Vegetation Structure

Riparian vegetation structure was monitored using the same protocols as described in Section 4.1.2.1.

Shading

Shading was monitored using the same protocols as described in Section 4.1.2.1.

Actively Eroding Stream Banks

Protocol for Monitoring Effectiveness of Habitat Protection Projects (Crawford and Arnett 2004) was used to estimate the percent of the linear distance of the channel on both stream banks at each transect where active erosion is occurring at the active channel height. This procedure is described in Section 4.1.4.1.

Fish Species Assemblages

Protocol for Monitoring Effectiveness of Habitat Protection Projects (Crawford and Arnett 2004) was used with modification to assess fish assemblages in acquisition properties. This protocol describes one-pass electrofishing or snorkel surveys for monitoring fish species assemblages. In some of the acquisitions, endangered species present prevented the use of electrofishing due to the chance of harming listed species. Instead, snorkel surveys were used at all sites to survey fish populations to enable comparisons among sites. Traditional snorkel surveys were combined with quadrat sampling snorkel surveys. Traditional snorkel surveys were conducted as described in Protocol for Monitoring Effectiveness of Habitat Protection Projects (Crawford and Arnett 2004) from the bottom of the reach to the top, counting all fish observed. Quadrat surveys involved placing a 30-cm square quadrat on the substrate and lifting rocks one at a time while a pair of snorkelers viewed the quadrat. Each snorkeler had a small aquarium net and the nets were used to capture fish hiding in the benthos (mainly sculpin). Fish captured were identified using viewing boxes and then returned to the stream. No injury or mortality of fish occurred during the 2004 sample season using this procedure. The quadrat was set down eight times in riffle habitat within the sample reach. This process was used to assess the diversity of the fish assemblage without the potential for harming listed fish. All habitat protection projects were sampled this way to allow for comparison of data across sites. Fish were identified, length was measured or estimated, and any external anomalies were noted. For any unknown fish species, voucher specimens were collected and/or species photographed for future identification. Field guides allowed identification of all fish encountered in the 2004 field season. Fish were classified and data were analyzed according to Mebane's Fish IBI Procedures (C. Mebane, personal communication, November 2004).

Macroinvertebrate Species Assemblages

At the sample reach within the acquisition, eight D-frame kick net samples were collected according to the EMAP protocols for targeted riffle samples (Pecket et al. unpublished, Crawford and Arnett 2004). These samples were then combined for the entire reach. Invertebrates were separated from the substrate with a sieve and samples were preserved using 99 percent ethyl alcohol. Samples were sent to Aquatic Biology Associates (Corvallis, Oregon) for identification of species. IBI metrics based on family, tolerance scores of species, functional feeding groups, long-lived taxa, and taxa richness were calculated by the lab.

Upland Plants

The Protocol for Monitoring Effectiveness of Habitat Protection Projects (Crawford and Arnett 2004) describes the details for monitoring upland vegetation in habitat protection projects. The methodology described below is designed to quantitatively characterize the vegetation of a parcel.

Major vegetation polygons were delineated by visual inspection of orthophotos in GIS format (ArcView or ArcMap). The level of resolution of this delineation depended on the type of vegetation, but did, at a minimum, distinguish between forested, shrub steppe, and grassland communities. Within these vegetation types, stands that were visually distinct due to differences in stand age, level of disturbance, and dominant species were also separated.

In GIS format, transects were mapped within the vegetation types and geographical coordinates of the endpoints of each transect were determined. In situations where vegetation boundaries were expected to change, the transects were located to span ecotones.

In the field, the baseline transects were located and marked, and plots were randomly located along these transects. Ability to relocate transect origins was of primary importance, and the location of endpoints was modified based on landmarks in the field to facilitate relocation. GPS coordinates of origin stakes for transects were recorded, along with datum used.

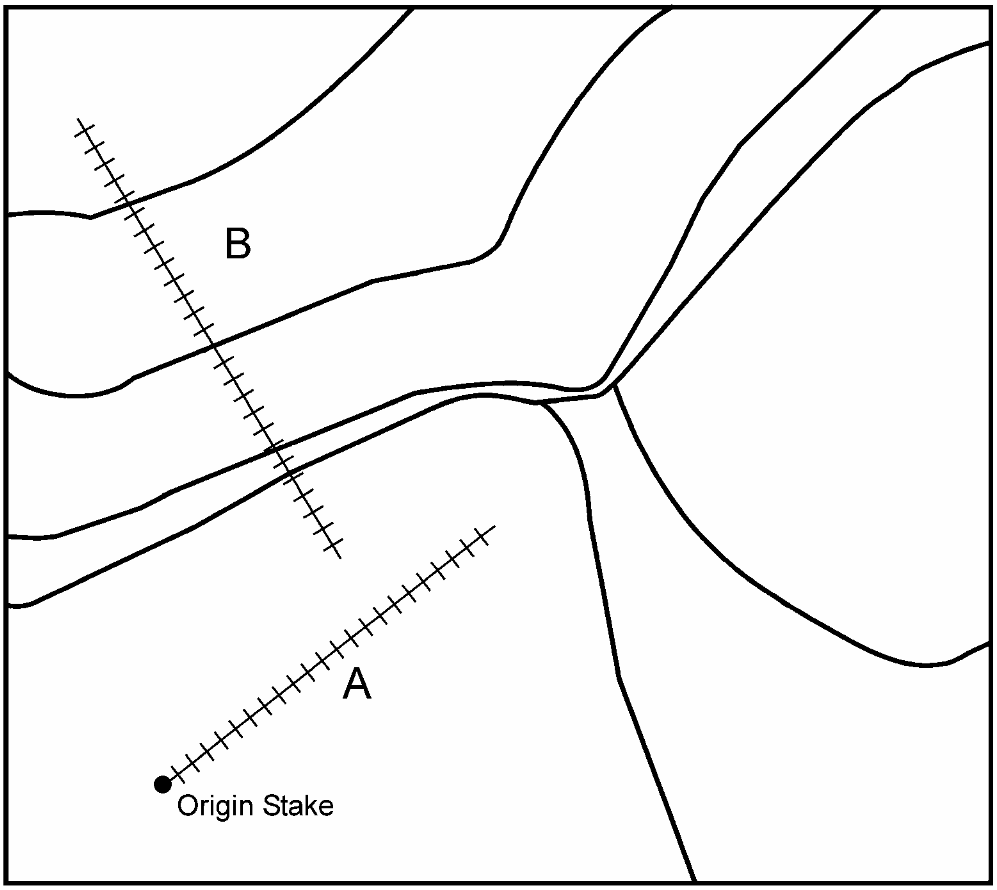


Figure 4-1. Diagrammatic Vegetation Polygons Showing Transect Locations

Transect type A is used to characterize vegetation within polygons. Transect type B is used to monitor changes in location of polygon boundaries. In forested polygons, circular plots would be randomly located at points on type A transects.

For grassland plots, each transect segment starting point was a random point that was established along the baseline transect, at minimum intervals of 10 meters. Plots were established as ten 1-meter segments of the baseline extending for 10 meters beyond each designated transect segment starting point. Each 1-meter section of the transect was established as a plot, in which species composition and coverage were recorded. In addition to species coverage, coverage of mosses and lichens (not by species) and bare ground were recorded. Average height by vegetation type was recorded within each plot. Shrub plots were monitored in the same manner as the grassland plots.

In forest plots, circular plots centered on points randomly selected along the transects were established as described above. These plots were marked with a single marker, eliminating the need for recording, marking, and geo-referencing the corners of the plot. For sampling trees, a 1/25-hectare circular plot was used, and all trees were recorded by species, diameter-at-breast-height (dbh) size class, and average tree height by canopy layer.

4.2.1.2 Estuary Habitat Protection Projects

The species, composition, and percent cover of herbaceous vascular plants, including invasive plants were monitored at two SRFB-funded estuary habitat protection projects. Vegetation polygon delineation included visual inspection of orthophotos in GIS format followed by field assessment including plant community determination and vegetation condition interpretation. A permanent vegetation transect was located such that the baseline transect lay perpendicular to the shore so it crossed the various intertidal elevations, and transect segments were located at even spacing along the baseline transect. Plant species, composition, and percent cover of herbaceous vascular plants, including invasive plants, were recorded along the lateral transects along with type of substrate present. Slope of the beach was also recorded.

4.2.2 Results/Data Summaries/Decision Criteria

Table 4-9 identifies the summary statistics for habitat protection projects. Variables followed by "_M" are only collected in estuary habitat. Habitat protection projects in estuary habitat will not have freshwater habitat or biological summary statistics.

Table 4-9. Response Variable Decision Criteria for Habitat Protection

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Riparian Condition	Mean percent canopy density at the bank densitometer reading (XCDENBK)	1-17 score	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Three-layer riparian vegetation presence (proportion of reach) (XPCMG)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Actively eroding banks (BANK)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12

Table 4-9. Response Variable Decision Criteria for Habitat Protection (continued)

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Stream Morphology	Mean residual pool vertical profile area (AREASUM)	m^2	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Mean residual depth (RP100)	cm	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Percent substrate embedded (XEMBED)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Percent substrate as fines (PCT_FN)	%t	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Large Wood (Log10 (V1WM100)	m^3	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
Stream Animal Assemblages	Macroinvertebrate Multimetric Index (MMI INVERT)	MMI score	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Fish species Assemblages (FISH INDEX)	FI score	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
Upland Habitat	Percent cover of non-native vascular plant species (HERB_NN)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Percent cover of non-native shrub species (SHRUB_NN)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Basal area of conifers per acre (BA_CONIF)	ft^2/acre	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Stem count of conifers per acre (SA_CONIF)	#/acre	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Basal area of deciduous trees per acre (BA_DECID)	ft^2/acre	Linear regression or non-narametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Stem count of deciduous trees per acre (SA_DECID)	#/acre	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12

Table 4-9. Response Variable Decision Criteria for Habitat Protection (continued)

Monitoring Parameters	Indicators[1/]	Unit	Test Type	Decision Criteria
Estuary Habitat (only)	Percent of the length of the intertidal transect with algae (ALGAE_M)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Linear extent of algae along the intertidal transect (LN_ALGAE_M)	m	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Percent of the length of the intertidal transect with vascular plants (VASCULAR_NN_M)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Linear extent of vascular plants along the intertidal transect (LN_VASCULAR_NN_M)	m	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Percent slope from mean high tide to mean low tide or low water (SLOPE_M)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Percent of the length of the intertidal transect with fine sediment (PCT_FN_M)	%	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12
	Linear extent of fine sediment along the intertidal transect (LN_FN_M)	m	Linear regression or non-parametric test	Alpha =0.10. Detect a minimum 20% change between Base Year 0 and Year 3, 6, 9, or 12

Source: Adapted from Crawford and Arnett (2004)
[1/] Variable names in all caps relate to database variables in Section 4.2.3.

Subjective ecological conditions were assigned to plant associations based on the criteria shown in Table 4-10.

Table 4-10. Rating Criteria for Vegetation Quality

Rating	Description
A Excellent	Plant association is pristine, appears to have experienced little or no present or past disturbance by post-industrial humans, is a large stand, or exhibits exceptional species diversity.
B Good	Plant association is in good to very good condition. Species composition and diversity are within the range expected for the type.
C Moderate	Plant association is somewhat degraded or recovering. While species diversity is typically low, environment and species composition are similar to published source.
D Poor	Plant association is degraded by logging, grazing, development, or by non-native species, although it is still recognizable as a described community.
E Extirpated	Plant association is completely altered and unrecognizable. Non-natives dominate.

Source: Adapted from Washington Natural Heritage Program Field Methodology (NatureServe 2002)

Macroinvertebrate data results can be interpreted using the grading system in Table 4-11.

Table 4-11. Macroinvertebrate Multimetric Index Grading System

Narrative Assessment	Puget Lowlands	Cascades	Columbia Plateau
Good	>30	>28	>34
Fair	20-30	23-28	23-33
Poor	<20	<23	<22

Source: Wiseman 2003

Fish species assemblage scores can be interpreted using the grading system in Table 4-12.

Table 4-12. Fish Species Assemblage Grading System

Score	Rating	Description
75-100	Good	Possessing or approaching biological integrity. Minimal disturbance. Hosts a diverse and abundant assemblage of species.
50-75	Fair	Somewhat lower quality waters where socially desirable alien species are present, reflecting relatively high-quality physical and chemical habitats. Native cool water species are dominant, but generally tolerant species occur more frequently.
<50	Poor	Poor quality habitat. Cold water and sensitive species are rare or absent, and generally tolerant species predominate.

Source: Mebane et al. 2003

4.2.3 Project-Specific Summaries

MC-10 Habitat Protection Projects

02-1353 Logging Camp Canyon Acquisition

Above: Transect F looking upstream
Below: Transect F looking downstream

Location: This project is located in Klickitat County within the Klickitat River Basin (WRIA 30) 4 miles south of the town of Klickitat. The sample reach is located on Logging Camp Creek within Township 4N, Range 13E, at the southeast corner of Section 31. The midpoint of the sample reach is at 45° 47' 9.97118" N; 121° 13' 30.67660" W.

GPS Coordinates				
REACH		Upstream		Downstream
Acquisition	lat	46 51 29.3	lat	56 51 23.6
	long	122 18 31.1	long	122 18 11.6

Objective/Intent: This parcel contains 293 acres of land critical to the long-term protection of steelhead spawning habitat. Logging Camp Creek provides one of the last and best vestiges of quality spawning and rearing habitat accessible to steelhead and coho salmon in the entire Klickitat River watershed.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics	
Variable [1/]	**Data**
Mean Residual Pool Vertical Profile Area (m^2)	4.91
Mean Residual Depth (cm)	3.27
Volume of LWD (m^3)	0.89
Percent Fines (%)	0.00
Percent Embedded (%)	7.36
Reach Length (m)	150.00
Reach Width (m)	16.78
Riparian Characteristics	
Canopy Density (1-17)	15.67
Riparian Vegetation Structure (%)	73.00
Bank Erosion (%)	19.25
Riparian Plant Characteristics	
Non-native Herbaceous Cover (%)	19.60
Non-native Shrub Cover (%)	0.00
Coniferous Basal Area (ft^2/acre)	0.00
Coniferous Density (stems/acre)	0
Deciduous Basal Area (ft^2/acre)	171.90
Deciduous Density (stems/acre)	510
Stream Organism Indices	
Fish Species Assemblage Index	61
Macroinvertebrate Multimetric Index	34

[1/] See Tables 4-1 and 4-9 for explanation of variables.
Data collected July 15, 2004.

Project Sponsor: Columbia Land Trust
Contacts: Cherie Kearney, Ian Sinks, Columbia Land Trust
Landowner: Bill Giersch

Upland Vegetation Summary

The following notes refer to polygons numbered in Figure 4-2.

Polygon 1: Steep grasslands at the western end of the property, south aspect. Abundant grasses and annual and perennial forb species, including *Lomatium* species, most notably *L. grayi*, with lesser amounts of *L. columbiana* and *L. suksdorfii*, and grasses, similar to the area sampled on Transect 2, with occasional oaks in draws, numerous shrubs in favorable sites. Non-native grasses abundant in localized places. Overall Condition Class B, according to Washington Natural Heritage Program rating system.

Polygon 2: Mixed forest, primarily coniferous, dominated by Douglas-fir, with a few oaks, and with scattered shrubby areas. This polygon includes areas that were apparently harvested within the past 10 or 15 years. Overall Condition Class C/D.

Polygon 3: Oak forest, including Transect 1. The developed stands, as sampled in Transect 1, were dominated by oaks and native species of grass and elk sedge, with non-native *Bromus* species well represented. In more rocky portions of this polygon, the shrub species occurred in higher covers. Overall Condition Class B/C.

Polygon 4: Steep, south-facing slope dominated by grasses and forbs, including Transect 2. Abundant grasses and annual and perennial forb species, including *Lomatium* species, most notably *L. grayi*, with lesser amounts of *L. columbiana* and *L. suksdorfii*. Occasional narrow draws reach up the slope and provide corridors of oaks and numerous shrubs. Overall Condition Class C. Non-native grasses are abundant, but native species diversity is high, including *Lomatium suksdorfii*, a sensitive species.

Polygon 5: At the top of the steep slopes of Polygon 4 is a relatively level grass field. This area has been intensely grazed by cattle, and appeared to have a higher proportion of non-native grasses and forbs. The *Lomatium* species abundant on the slope of Polygon 4 were also absent, though *Lomatium nudicaule* was present. Overall Condition Class D/E. It is difficult to determine the native vegetation composition here.

Polygon 6: Steep stabilized basalt talus with well-developed coniferous forest, including occasional oaks and areas of more dense shrubs. Transect 3 is located in the lower portion of this polygon. Presumably all of this forest, dominated by Douglas-fir, has been historically logged, but not as recently as areas in Polygon 2. Overall Condition Class B/C. Vegetation is currently intact, recovering from the historical disturbance.

Polygon 7: Steep grassy openings, with numerous grass and forb species, north-facing, typically surrounded by oaks. Overall Condition Class B/C.

Polygon 8: Grassy openings, similar to Polygon 7. Overall Condition Class B/C.

MC-10 Habitat Protection Projects

02-1353 (continued)

Polygon 9: Steep, rocky slopes and outcrops, with patches of grasses and forbs interspersed with cliffs. Very high quality vegetation, with few non-native plants and a large population of *Heuchera grossulariifolia* var. *tenuifolia.* Overall Condition Class A/B.

Polygon 10: This polygon also includes coniferous forest, similar to Polygon 6, but in general it is more level and appears to be a better growing site. Overall Condition Class B/C. Vegetation is currently intact, recovering from the historical disturbance.

Polygon 11: This polygon includes a relatively level forested area, beyond the rim of Logging Camp canyon, and includes mixed conifers, predominantly Douglas-fir, with a few oaks. This area has all been logged at one time or another but has grown back up to second-growth forest. Overall Condition Class C. Disturbance is more recent than the steeper slopes, but the vegetation is recovering.

Transects described below were used to calculate the non-native percent cover of herbaceous and shrub species.

Transect 1: Oak forest with approximately 70% cover (Figure 4-2)

Transect Heading: 330^o

Meters from Transect Origin	Tag Number	Latitude 45^o 47' (seconds)	Longitude 121^o 13' (seconds)	GPS EPE (m)	Stake Location from Tree Tag (all tags on oak trees)
Origin	13	14.1	40.1	5.5	Below tag, E of tree
2	18	13.7	40.3	12.8	
15	17	13.8	40.2	0	1.8m WSW of tree
52	14	15.4	41.4	0	1.5m ESE of tree
65	15	16.0	14.4	0	1.5m SSW of tree
77	16	15.6	41.7	0	3.7m SSW of tree

Transect 2: Herbaceous

Transect Heading: 270^o

Meters from Transect Origin	Tag Number	Latitude 45^o 47' (seconds)	Longitude 121^o 13' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	19	11.8	07.3	0	Below tag, 0.4m S of small oak tree
12	No stake	11.8	07.7	0	No trees
31	20	11.6	8.6	0	No trees
41	No stake	11.7	09.2	0	No trees
61	No stake	11.8	10.1	0	No trees
76	21	11.7	10.7	5.5	No trees

02-1353 (continued)

Transect 3: Primarily coniferous forest with 90 to 100 percent cover

Transect Heading: 200°

Meters from Transect Origin	Tag Number	Latitude 45° 47' (seconds)	Longitude 121° 13' (seconds)	GPS EPE (m)	Stake Location from Tree Tag	Notes
Origin	22	08.0	28.2	9.1	Below tag on large Douglas-fir	
12	23	06.6	26.2	0	3.7m NE of tag on Douglas-fir	
33	24	7.0	29.5	18.3	3.5m NNE of tag on tree along the transect line	Old road crosses transect at 25 m.
43	25	09.8	28.6	9.1	4.6m NNE of tag on Douglas-fir along the transect line	
61	26	6.4	29.4	25.9	0.9m NE of tag on Douglas-fir	
83	27	05.6	30.5	12.2	0.6m SE of small Douglas-fir	

Above: View of Transect 2

MC-10 Habitat Protection Projects

02-1353 (continued)

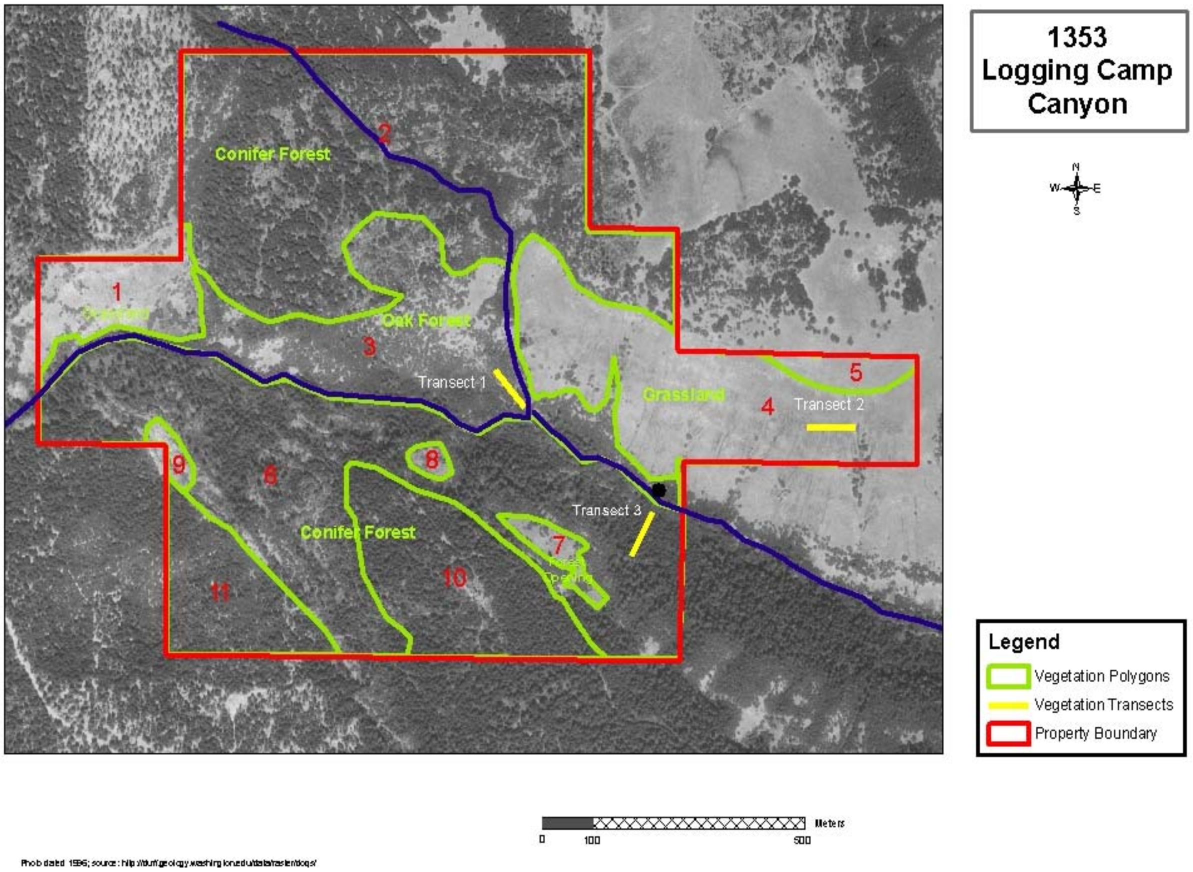


Figure 4-2. Polygons and Transects at Logging Camp Canyon Acquisition

MC-10 Habitat Protection Projects

02-1535R WeyCo Marshal Shoreline Acquisition

Above: Transect F looking upstream
Below: Transect K looking downstream

Location: Pierce County. Nisqually River Basin. Near Eatonville, Washington.

GPS Coordinates				
REACH		Upstream		Downstream
Acquisition	lat	46 51 29.3	lat	56 51 23.6
	long	122 18 31.1	long	122 18 11.6

Objective/Intent: This parcel of land contains 65 acres of timberland with old-growth values. Purchasing the land adds to salmonid habitat preservation and prevents it from being logged and developed. Ultimately, land is to be transferred to state parks after permanent protection of stream corridor is guaranteed.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics	
Variable [1/]	Data
Mean Residual Pool Vertical Profile Area (m^2)	92.3
Mean Residual Depth (cm)	18.5
Volume of LWD (m^3)	1.50
Percent Fines (%)	0.00
Percent Embedded (%)	36.10
Reach Length (m)	500.00
Reach Width (m)	20.30
Riparian Characteristics	
Canopy Density (1-17)	8.00
Riparian Vegetation Structure (%)	55.00
Bank Erosion (%)	0.00
Riparian Plant Characteristics	
Non-native Herbaceous Cover (%)	0.02
Non-native Shrub Cover (%)	0.04
Coniferous Basal Area (ft^2/acre)	219.20
Coniferous Density (stems/acre)	231
Deciduous Basal Area (ft^2/acre)	14.40
Deciduous Density (stems/acre)	58
Stream Organism Indices	
Fish Species Assemblage Index	75
Macroinvertebrate Multimetric Index	28

[1/]See Tables 4-1 and 4-9 for explanation of variables.
Data collected July 12, 2004 and June 23, 2004.

Project Sponsor: Nisqually River Basin Land Trust
Contact: George Walter
Landowner: The Weyerhauser Company

Upland Vegetation Summary

Two vegetation polygons were delineated in the Weyco Mashel Shoreline Acquisition and are shown in Figure 4-3.

Polygon 1: Most of the project site is a mature mixed forest that includes conifers and broad-leaved trees. Logging has historically occurred on this site, many years ago, and the stand has developed mature characteristics. Condition Class B/C.

Polygon 2: This small polygon close to the Mashel River is predominantly broad-leaved trees, with dense shrubs near the river's edge. Cobbles along the stream bed include numerous non-native species. Condition Class C/D.

Transect 1

Transect Heading: 310 ° for the first 32 meters, then 220° to the end. The 90 ° bend was used to avoid a hazard tree/hung log. The first four transect segments, including the segment that begins at 62 meters, lie in the 310 ° line. The fifth, at 80 meters, lies in the 220° line.

Summary of Transect 1 Information

Meters from Transect Origin	Tag Number	Latitude 46 ° 51' (seconds)	Longitude 122 ° 18' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	43	28.6	26.8	10	Below tag on THPL
16	44	19.5	27.2	8	15 m SE of tag on 0.5m dbh THPL. Actually visible from origin.
32	45	29.6	27.8	6	1 m NE of tag on THPL. Segment starts on a steep downhill at 40 m.
51	46	30.2	28.6	6	4 m E of tag on ACMA (0.3m dbh)
62	47	31.5	29.0	7	8 m W of tag on TSHE
80	48	29.5	29.4	8	4 m from 0.8m DBH TSHE

MC-10 Habitat Protection Projects

02-1535R (continued)

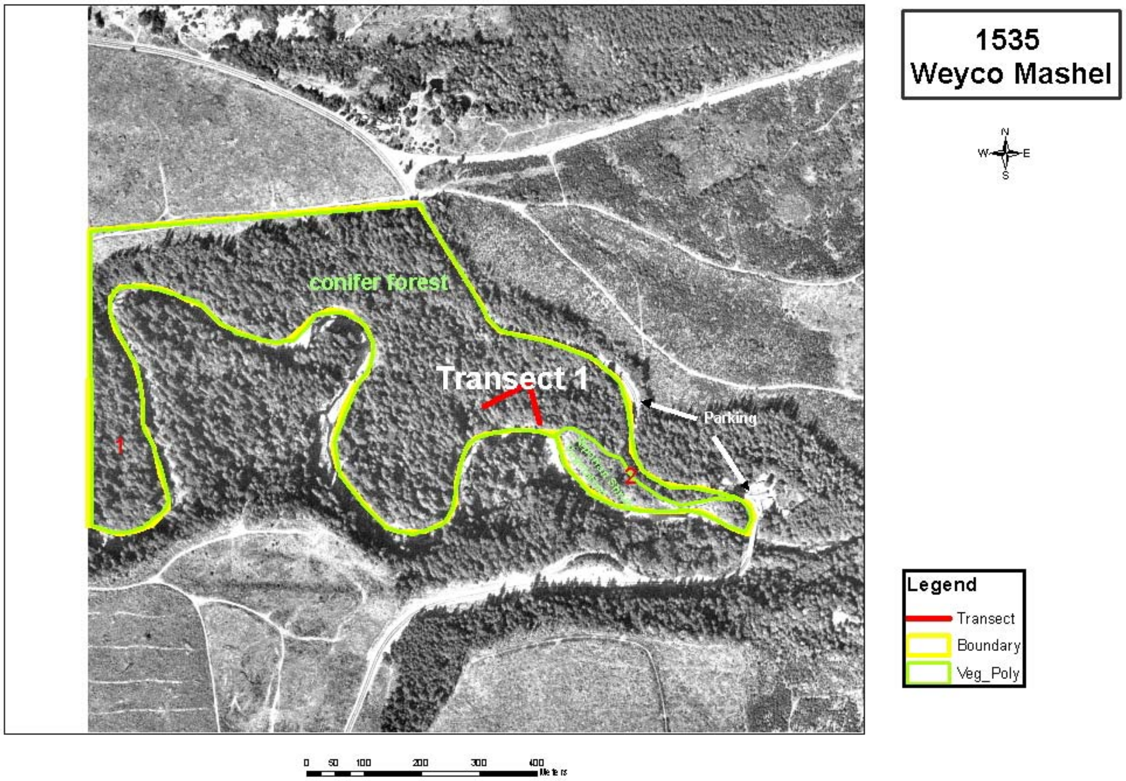


Photo dated 1989; source: http://duff.geology.washington.edu/data/raster/doqs/

Figure 4-3. Polygons and Transects at the Weyco Mashel Shoreline Acquisition

Above: Typical Vegetation

MC-10 Habitat Protection Projects

02-1622A Issaquah Creek Log Cabin Reach Acquisition

Above: Looking upstream from the x-site (mid-point of the biological survey reach)

Location: King County, Middle Issaquah Creek Basin.

GPS Coordinates				
REACH		Upstream		Downstream
Acquisition	lat	47 28 7.1	lat	47 28 14.5
	long	122 1 59.1	long	122 2 2.7

Objective/Intent: Acquire and protect 152 acres of mature forests, wetlands, and riparian corridor along 1 ¼ mile of both sides of Issaquah Creek. This will protect rearing and spawning habitat for ESA listed Chinook salmon, char, sockeye salmon, coho salmon, kokanee salmon, steelhead, cutthroat trout, and possibly bull trout as well as protect the water quantity and quality for all of Issaquah Creek. The parcels include various habitats and refugia for the above species as well as providing a link in the wildlife corridor that incorporates Tiger Mountain and Squak Mountain state forests.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics	
Variable [1/]	**Data**
Mean Residual Pool Vertical Profile Area (m^2)	49.29
Mean Residual Depth (cm)	15.90
Volume of LWD (m^3)	0.58
Percent Fines (%)	0.00
Percent Embedded (%)	44.90
Reach Length (m)	310.00
Reach Width (m)	7.72
Riparian Characteristics	
Canopy Density (1-17)	13.05
Riparian Vegetation Structure (%)	27.00
Bank Erosion (%)	1.50
Riparian Plant Characteristics	
Non-native Herbaceous Cover (%)	34.38
Non-native Shrub Cover (%)	0.00
Coniferous Basal Area (ft^2/acre)	153.10
Coniferous Density (stems/acre)	63.00
Deciduous Basal Area (ft^2/acre)	43.76
Deciduous Density (stems/acre)	19.00
Stream Organism Indices	
Fish Species Assemblage Index	71
Macroinvertebrate Multimetric Index	42

[1/] See Tables 4-1 and 4-9 for explanation of variables.
Data collected June 22, 2004.

Project Sponsor: King County Water and Land Resources Division
Contact: Mary Maier, Connie Blumen, Steve Williams
Landowners: Anderson, Alman, Bain

MC-10 Habitat Protection Projects

02-1622A (continued)

Upland Vegetation Summary

The following notes correspond to numbering on the vegetation map, Figure 4-4.

Polygon 1: Second-growth mixed forest. Did not get onto the ground on the west side of the river. Young homogenous forest, mixed species. Condition Class C.

Polygon 2: Riparian vegetation, predominantly shrubs and herbaceous, with scattered trees, both conifers and broad-leaved species. Relatively disturbed by historical development. Condition Class C.

Polygon 3: Mature coniferous forest, including Transect 2. Some evidence of past logging, but a scattering of fairly large trees and native understory species. Condition Class B.

Polygon 4: Mixed forest, conifers and broad-leaved species, past disturbance, including farming and roads. Fairly abundant non-native species in some areas, but growing back to native forest. Condition Class C.

Polygon 5: Grassy field, maintained at least until recently by mowing. Predominantly non-native, Condition Class E.

Above: View of vegetation at Issaquah Log Cabin Acquisition

Transects described below are shown in Figure 4-4.

MC-10 Habitat Protection Projects

02-1622A (continued)

Transect 1: Herbaceous transect in grass field

Transect Heading: 75°; Transect heads directly toward a lone cottonwood on Cedar Grove Road. The top half of the cottonwood can be seen from the transect origin.

Transect 1

Meters from Transect Origin	Tag Number	Latitude 47° (seconds)	Longitude 122° 01' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	49	27' 59.8	43.5	6	Below tag, on east side of lone alder
16	-	28' 0.0	42.0	5	
32	-	28' 2.0	41.3	9	
51	-	28' 0.2	40.7	8	
62	-	28' 0.2	40.7	8	
80	-	28' 0.5	39.7	8	

Transect 2: Forested transect east of river. Open forest with old-growth characteristics.

Transect Direction: 65°

Meters from Transect Origin	Tag Number	Latitude 47° 28' (seconds)	Longitude 122° 02' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	50	18.5	3.7	1.8	Below tag on east side of 1.2m dbh cedar
12	51	18.1	3.1	1.8	8 m NE of tag on 1.1m dbh cedar
22	52	18.6	2.8	3.7	5m east of tag on big leaf maple
54	53	18.2	1.6	3.7	
66	54	19.3	0.8	2.4	
76	55	19.2	01' 59.8	2.7	

MC-10 Habitat Protection Projects

02-1622A (continued)

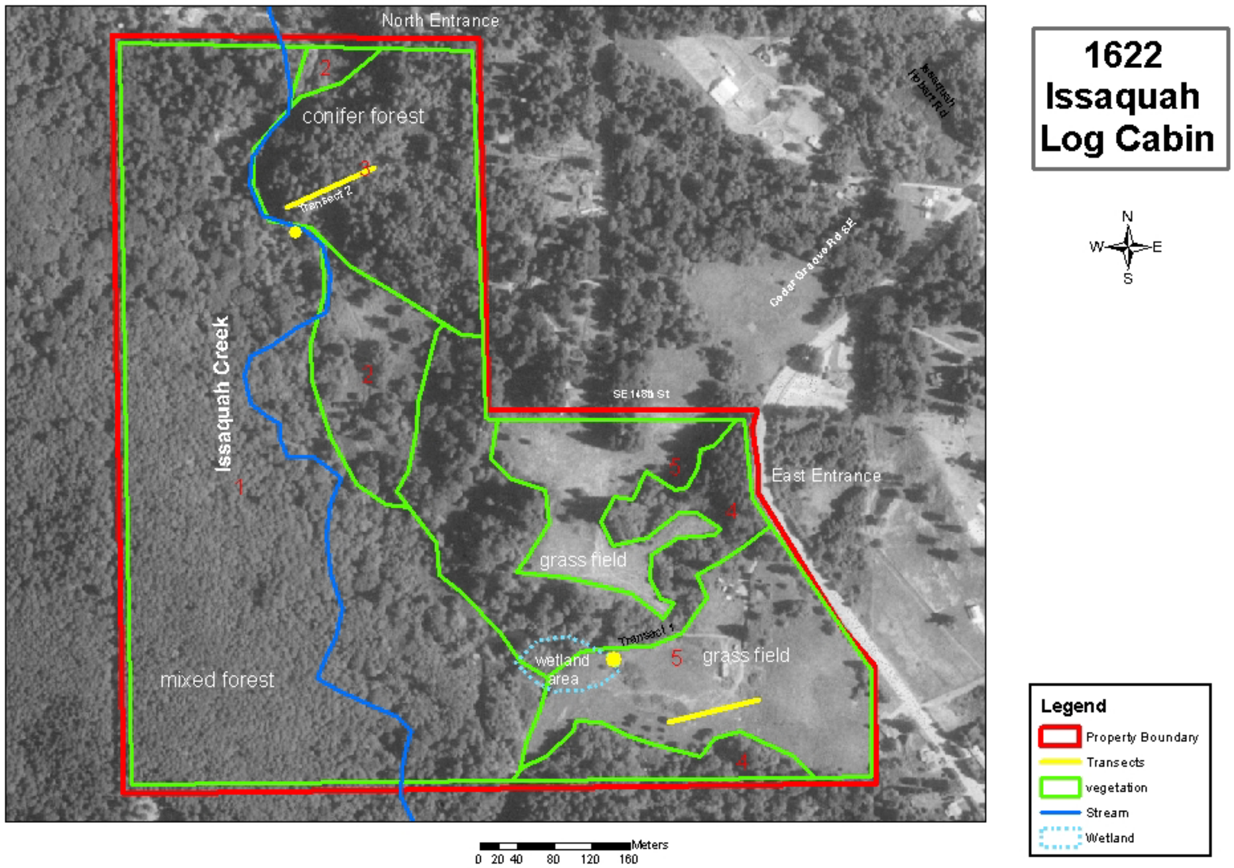


Photo dated 1990; source: http://duff.geology.washington.edu/data/raster/doqs/

Figure 4-4. Polygons and Transects at the Issaquah Log Cabin Acquisition

MC-10 Habitat Protection Projects

02-1650 Methow Critical Habitat Area Acquisition

Above: Transect F looking upstream
Below: Transect F looking downstream

Objective/Intent: This project establishes conservation easements on multiple property parcels on the Methow River between the towns of Mazama and Winthrop to protect the Upper Methow Habitat Block, a corridor of extremely high-quality riparian habitat where side channels, large woody debris, and spawning areas are abundant. Steelhead and Chinook salmon are expected to benefit most from this project.

Location: This project is located in Okanogan County between the towns of Winthrop and Mazama within the Methow River Basin (WRIA 48). The sample reach is located on the Tawlks property on the mainstem Methow River within Township 36N Range 20E Section 32. The midpoint of the sample reach is at 48° 34' 28.13290" N; 120° 22' 19.08723" W.

GPS Coordinates				
REACH		Upstream		Downstream
Acquisition	lat	46 51 29.3	lat	56 51 23.6
	long	122 18 31.1	long	122 18 11.6

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics	
Variable[1/]	**Data**
Mean Residual Pool Vertical Profile Area (m^2)	9.65
Mean Residual Depth (cm)	1.93
Volume of LWD (m^3)	1.50
Percent Fines (%)	0.00
Percent Embedded (%)	9.45
Reach Length (m)	500.00
Reach Width (m)	23.30
Riparian Characteristics	
Canopy Density (1-17)	3.68
Riparian Vegetation Structure (%)	9.00
Bank Erosion (%)	22.50
Riparian Plant Characteristics	
Non-native Herbaceous Cover (%)	64.69
Non-native Shrub Cover (%)	0.00
Coniferous Basal Area (ft^2/acre)	1.75
Coniferous Density (stems/acre)	30
Deciduous Basal Area (ft^2/acre)	1,618.40
Deciduous Density (stems/acre)	446
Stream Organism Indices	
Fish Species Assemblage Index	62
Macroinvertebrate Multimetric Index	38

[1/]See Tables 4-1 and 4-9 for explanation of variables. Data collected August 11 and 12, 2004.

Project Sponsor: Methow Conservancy;
Contacts: Katharine Bill, Steve Bondi
Landowners: Tawlks, Brown, Edelweiss, and Stean

02-1650 (continued)

Upland Vegetation Summary

General Description – All four properties are on the Methow River. Three properties (Tawlks, Brown, Edelweiss) are north of Winthrop and one, Steans, is south of Winthrop. The three properties north of Winthrop are largely undeveloped and adjacent to the river. The Stean property has been cleared and farmed, and the stream had a tree buffer of only a few feet. Recently, seedlings have been planted along the narrow tree buffer.

Stean Property

The following notes for polygons on the Stean property correspond with polygon numbers on Figures 4-5 and 4-6.

Polygon 1: Narrow band of sagebrush steppe along the west side of Highway 20. Condition Class C/D.

Polygon 2: Mix of old gardens, existing farm buildings, a house, driveways, and small fields. Condition Class E.

Polygon 3: Grass field, likely recently plowed and planted. Condition Class E.

02-1650 (continued)

Polygon 4, Two Locations: Two areas where riparian plantings have been made. These areas are formerly grass fields, and a variety of native shrubs and trees were planted here within the past 2 years. Mortality has been fairly high. One site is at the extreme north end of the property, between deciduous trees along the river and the grass field of Polygon 3. The second area is just north of the black cottonwood stand that is crossed by Transect 1, parallel to the deciduous trees along the river. Currently Condition Class E, but potentially will rapidly improve.

Polygon 5: This is a narrow band of deciduous trees along the immediate bank of the Methow River. Primarily black cottonwood, Condition Class C, based on the species that would normally be here, but this is a narrow band of individual trees.

Polygon 6: Planted (in 2004) alfalfa field. Condition Class E.

Polygon 7: Lithosol outcrop, native vegetation more prevalent here than elsewhere on the parcel, other than the deciduous forest sites. Includes one small swale of Great Basin rye. Condition Class C.

Polygon 8: Grass field, predominantly non-native species, recently cut, but now possibly being let go back to wild conditions. Condition Class E.

Polygon 9: Narrow band of sagebrush steppe between Highway 20 and Witte Road. Condition Class C/D.

Polygon 10, Two Areas: Deciduous forest between the Methow River and farm fields. Predominantly native trees and shrubs with abundant non-native herbaceous understory species. Condition Class C/D.

Polygon 11: Stand of deciduous black cottonwood trees surrounded by previously mowed fields. Predominantly native trees and shrubs with abundant non-native herbaceous understory species. Condition Class C/D.

Transects described below are also located on Figures 4-5 and 4-6.

Transect 1: From the origin to 29.3 meters is grassland; 29.3 to 46.7 m is POBA forest, 46.7 to 62.8 is grassland with seedling plantings (various shrub and tree) and 63 meters to the river is POBA forest.

Transect Direction: 60 ^{o}

Meters from Transect Origin	Tag Number	Latitude N 48° 27' (seconds)	Longitude W 120° 09' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	1	22.1	56.7	3.7	Beneath tag on E side of *Amelanchier alnifolia*
Plot 1-52: 15.76	-			0.0	No tag, potentially mowed field
Endpoint 71	3	23.1	53.7	7.0	Below tag on NW side of POBA that is at edge of river

MC-10 Habitat Protection Projects

02-1650 (continued)

Transect 2: Cottonwood stand

Transect Direction: 120°

Meters from Transect Origin	Tag Number	Latitude N 48° 27' (seconds)	Longitude W 120° 09' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	2	22.7	54.7	0.0	Below tag on NE side of POBA at 38 m on Transect 1.
9	4	22.6	54.8	0.0	
25	5	22.1	53.8	0.0	
Endpoint 36	6	22.2	53.7	0.0	Below tag on POBA. This is origin for Transect 3.

Transect 3: grassland (previously farmed)

Transect Direction: 100°

Meters from Transect Origin	Tag Number	Latitude N 48° 27' (seconds)	Longitude W 120° 09' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	6	22.2	53.7	0.0	Below tag on POBA at 36 m on Transect 2.
3.6	-	22.2	53.7	0.0	
14.5	-	22.2	53.7	0.0	
29.4	-	22.1	53.7	0.0	
40.6	-	22.1	53.7	0.0	
Endpoint	7	22.7	50.1	0.0	Below tag on POBA approximately 7 m from river

Transect 4 : Black cottonwood forest along the Methow River.

Transect Direction: 140°

Meters from Transect Origin	Tag Number	Latitude N 48° 27' (seconds)	Longitude W 120° 09' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	7	21.7	50.1	0.0	Below tag on POBA that is endpoint for Transect 3
6	8	21.6	49.9	0.0	3 m E of tag
27	9	20.9	49.3	0.0	3 m E of tag
45	10	20.6	48.6	0.0	8 m SE of tag

Tawlks Property

Polygons described below are labeled in Figure 4-7.

Polygon 1: Stand of second-growth coniferous forest along the highway. Condition Class C.

Polygon 2: Mowed field, predominately non-native grasses, some native annuals. Condition Class E. Transect 5 was selected in a formerly mowed field in the lower part of Polygon 2, where apparently the mowing will not be continued and the vegetation will return over time to previous conditions, such as what is present in portions of Polygon 3.

Polygon 3: Riparian Forest. Diverse and complex mosaic of conifers and deciduous trees, crossed by flowing side channels of the Methow River. Some areas are quite dry, others are wetlands and stream channels. Condition Class B/C, though of higher ecological importance because of the diversity and the presence of the stream channels.

Polygon 4: Dry coniferous forest on the east side of the Methow River. Not visited at the time of this survey; presumably Condition Class C.

The transect identified below is shown in Figure 4-7.

02-1650 (continued)

Transect 5 starts near the south property line, near the east end of an existing barbwire fence that starts at the gate to the lower field and slopes down to the lower terrace where this transect is located in a formerly mowed field starting to be encroached upon by willows and other shrubs.

Transect Direction: 360°

Meters from Transect Origin	Tag Number	Latitude 48° 34’ (seconds)	Longitude 120° 22’ (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	11	8.1	21.5	0.0	Tag at base of 8-inch dbh THPL that is endpoint for Transect 5
9	none	8.4	21.6	0.0	
22	none	9	21.8	0.0	
33	none	9.1	21.8	0.0	
56	none	9.9	22.1	0.0	
67	none	10.3	22.1	0.0	
End point	12	10.8	22.0	0.0	End point at base of SASC at edge of stream

MC-10 Habitat Protection Projects

02-1650 (continued)

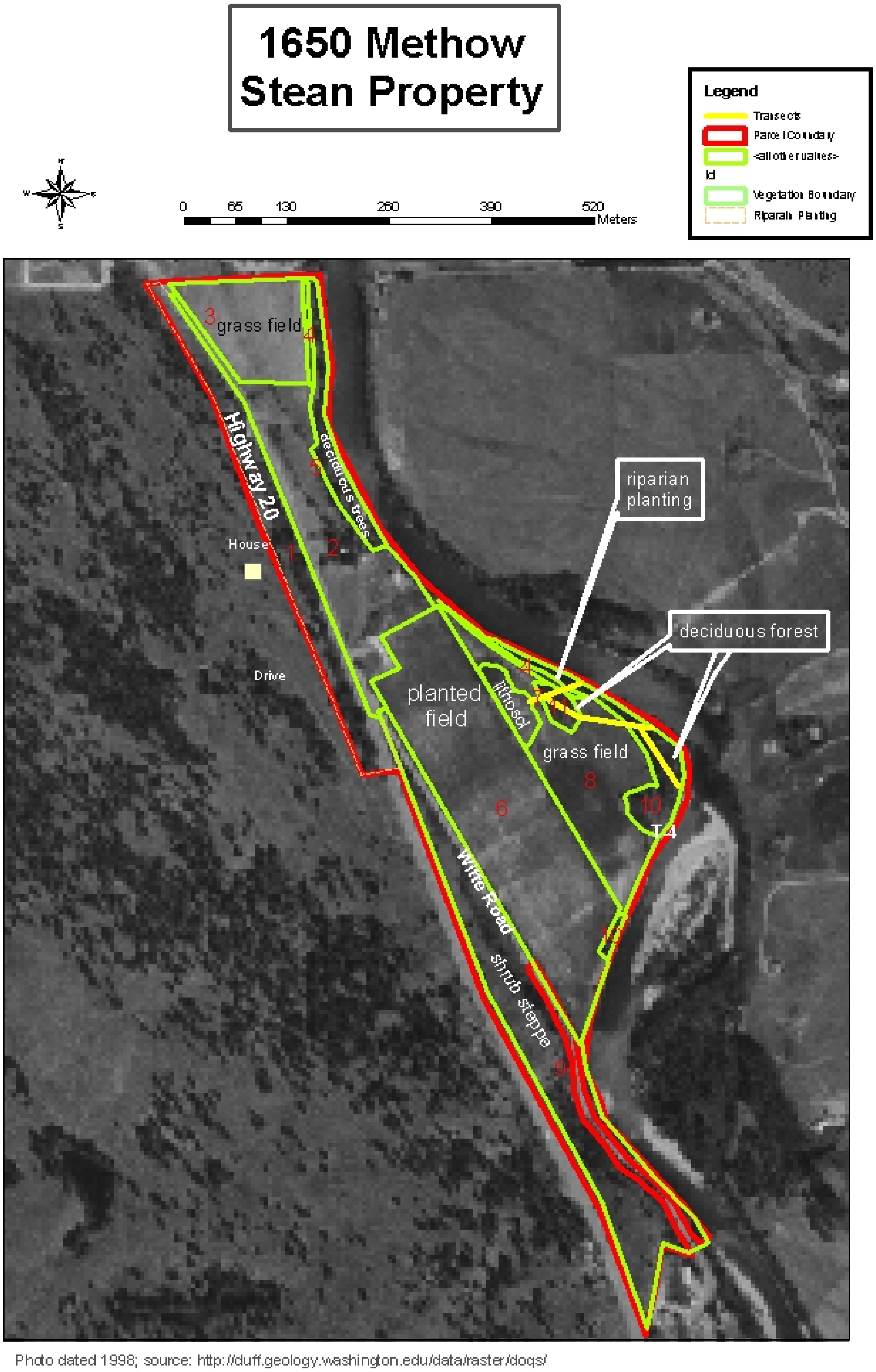


Figure 4-5. Polygons and Transects on the Stean Property, Methow Critical Riparian Habitat Acquisition

02-1650 (continued)

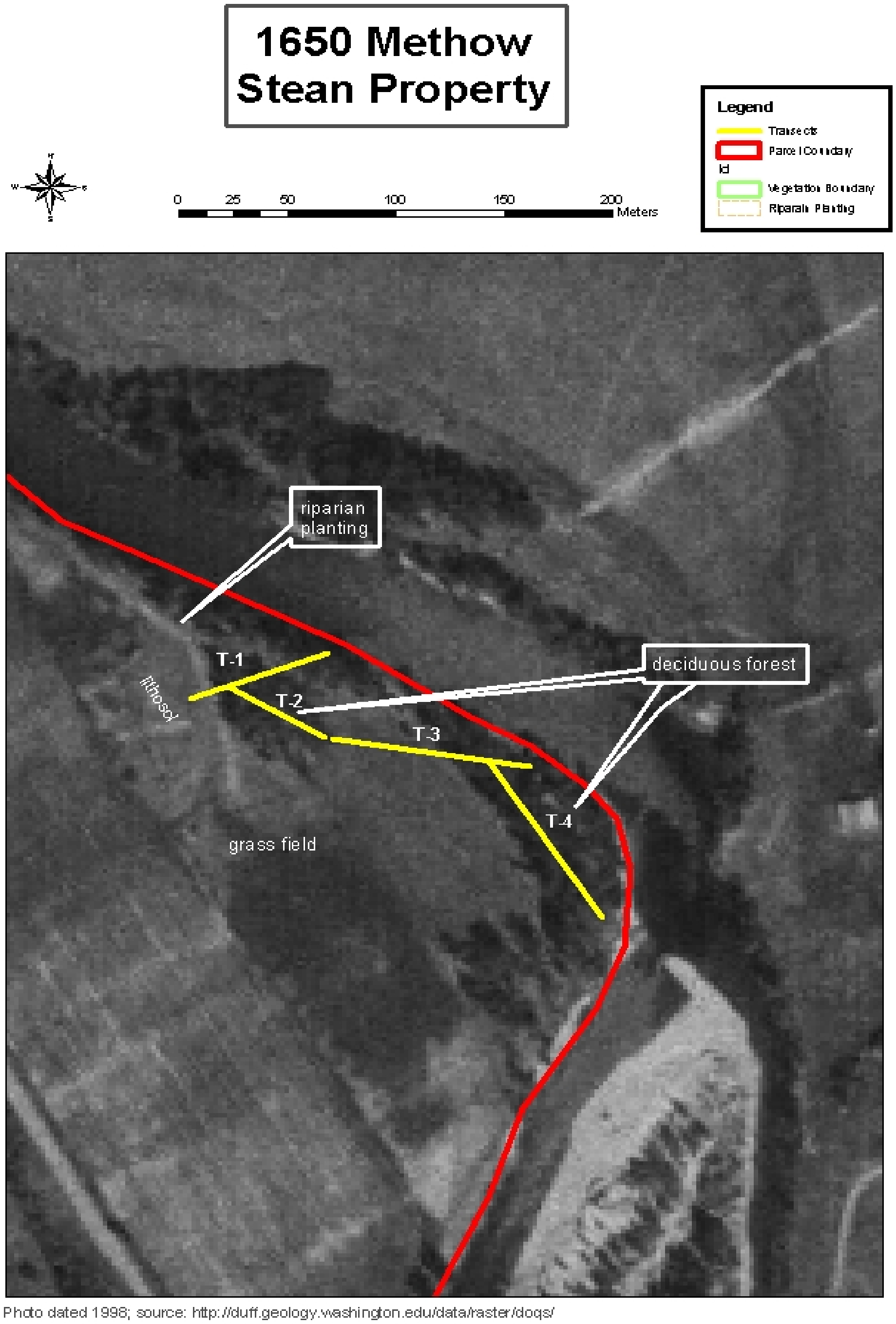


Figure 4-6. Transects on the Stean Property of the Methow Critical Riparian Habitat Acquisition

02-1650 (continued)

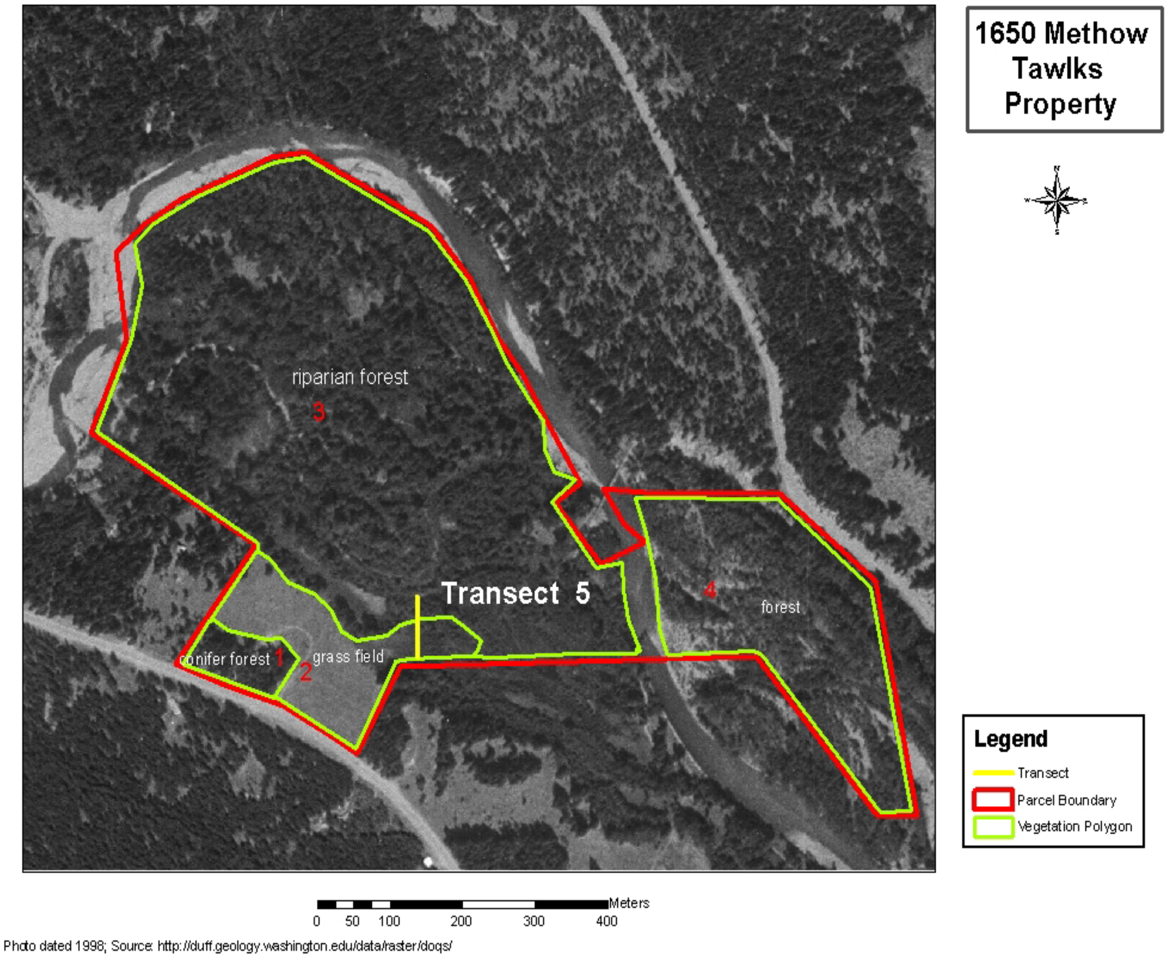


Figure 4-7. Polygons and Transects on the Tawlks Property of the Methow Critical Riparian Habitat Acquisition

MC-10 Habitat Protection Projects

02-1669 Entiat River Habitat Acquisition

Above: Transect F looking upstream
Below: Transect F looking downstream

Objective/Intent: This project permanently protects nearly 3 miles of some of the most important salmonid spawning and rearing habitat on the Entiat River. These properties all occur in the "stillwaters" region of the Entiat between river miles 16 and 26. Spring and summer Chinook salmon, steelhead, and non-anadromous bull trout all utilize this stretch of river.

Location: This project is located in Chelan County on the Entiat River (WRIA 46) between river miles 16 and 26. The sample reach is located on the Thomas property on the mainstem Entiat River just upstream from Stormy Creek within Township 27N Range 19E Section 22. The midpoint of the sample reach is at 47^{o} 49' 26.78080" N; 120^{o} 25' 19.70341" W.

GPS Coordinates				
REACH		Upstream		Downstream
Acquisition	lat	46 51 29.3	lat	56 51 23.6
	long	122 18 31.18	long	122 18 11.6

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics	
Variable[1/]	**Data**
Mean Residual Pool Vertical Profile Area (m^2)	287.46
Mean Residual Depth (cm)	61.16
Volume of LWD (m^3)	0.91
Percent Fines (%)	26.00
Percent Embedded (%)	66.90
Reach Length (m)	500.00
Reach Width (m)	16.98
Riparian Characteristics	
Canopy Density (1-17)	3.53
Riparian Vegetation Structure (%)	27.00
Bank Erosion (%)	29.25
Riparian Plant Characteristics	
Non-native Herbaceous Cover (%)	53.68
Non-native Shrub Cover (%)	0.00
Coniferous Basal Area (ft^2/acre)	0.00
Coniferous Density (stems/acre)	0
Deciduous Basal Area (ft^2/acre)	0.00
Deciduous Density (stems/acre)	0
Stream Organism Indices	
Fish Species Assemblage Index	Too few fish
Macroinvertebrate Multimetric Index	42

[1/]See Tables 4-1 and 4-9 for explanation of variables. Data collected August 31, 2004; September 1, 2004; and September 15, 2004.

Project Sponsor: Chelan-Douglas Land Trust
Contact: Gordon Congdon
Landowners: Malone, Beatley, Nava, Dill Creek Ranch - CJS, Thomas

Upland Vegetation Summary

General Description

The project includes two properties acquired by Chelan-Douglas Land Trust that are now open to the public. They are along the Entiat River, 16 to 17 miles up Entiat River Road. The properties lie in what is referred to as the still waters of the Entiat River.

The following notes are keyed to the polygon numbers on the site vegetation map, Figure 4-8.

Cottonwood Flats Property

Polygon 1: Cottonwood Flats is within the floodplain or meander zone of the river. This area included a mature cottonwood forest until the late 1990s. A bridge was built and the trees cleared in an attempt to build a housing project. Permits were not obtained because of the inability to build a septic system in that floodplain. The bridge and road had been built and two portions of the road have since been removed to allow flow. In 2004, black cottonwood and willow saplings were present in most areas and dense in some. The two areas of the loop road that had been removed were at least partial wetlands. The removal area closest to the bridge is dominated by *Phalaris arundinacea* (reed canary grass) and the former roadbed was beginning to show plant growth including several native sedges. The area that was removed on the southern part of the loop road was inundated and dominated by *P. arundinacea*, *Scirpus microcarpus, Carex retrorsa,* and *C. vesicaria.* Transect 2 is upland and is representative of the herbaceous areas with shrub growth.

On transect 2 non-native herbs made up 123% of the absolute cover, 66% of the relative cover of herbaceous species, and 56% of the relative cover of all plants. All woody species were native.

This area has been heavily altered, but is recovering, and the cottonwoods will soon establish a forest not profoundly different from the historical conditions, though the non-native species will remain. Currently it would be regarded at Condition Class D/E, but condition improvement will likely be rapid with continuing protection from further disturbance. This area is within the meander zone of the Entiat River, downstream and on the outside of a stream meander. It is likely that over long time frames the river meanders will migrate through the property. While this process includes cycles of disturbance, it is part of the natural vegetation cycle within the meander zone.

Polygon 2: This is the steep rocky side slope of the Entiat River valley. It is mostly talus with sparse vegetation, shrubs, and occasional trees. Condition Class C.

Polygon 3: Steep outcrop, sparsely vegetated, occasional burned trees. Condition Class B/C.

02-1669 (continued)

Polygon 4: Open coniferous forest, trees mostly dead from burning approximately 10 years ago. Condition Class C.

Polygon 5: Steep outcrop, sparsely vegetated, occasional burned trees. Condition Class C.

Stormy Creek Property

The property on the west side of the river was not visited, but the following brief notes are based on views from the east side of the river and from inspection of aerial photographs and topographic maps.

Polygon 6: Rock outcrop and talus, sparse vegetation, shrubs, and burned trees. From the aerial photo it appears that some logging may have occurred at this site. Condition Class C/D.

Polygon 7: Sparse conifer forest, likely including a mix of trees that were burned in the fires and trees that survived. Condition Class C.

Polygon 8: Sparse conifer forest, likely including a mix of trees that were burned in the fires and trees that survived. Condition Class C.

Polygon 9: Mixed forest within the meander zone of the river. Presume that disturbance levels are moderate, and the vegetation is Condition Class C. The value of this vegetation is markedly elevated because of its riparian location.

Polygon 10: Steep talus, sparse vegetation, sparse living trees. Condition Class is C.

Polygon 11: Rock outcropping, sparse vegetation, shrubs, and occasional burned trees. Expect that vegetation would be Condition Class B/C.

Polygon 12: Rock outcrop and talus, sparse vegetation, shrubs, and occasional trees, including some that burned in the fire. Expect that vegetation would be Condition Class C.

Polygon 13: Alluvium from the small creek flowing in from the west. Mostly shrubs. Expect that vegetation would be Condition Class C.

Polygon 14: Mostly grasslands within the meander zone of the river. This area had been historically cut for hay, and is the location of transect 1. Currently, it would be regarded at Condition Class E, but condition improvement will likely be rapid with continuing protection from further disturbance. Because this area is within the meander zone of the Entiat River, downstream and on the outside of a stream meander, it is likely that over time the river meanders will migrate through the property. While this process includes cycles of disturbance, it is part of the natural vegetation cycle within the meander zone. The vegetation here is dominated by non-native species, currently Condition Class D/E, but maintains a high diversity of native species and will continue to recover with continuing protection from disturbance.

02-1669 (continued)

On Transect 1, non-native herbs made up 89 percent of the absolute cover and 67 percent of the relative cover. Only one woody species, native hawthorne, was present on the transect and contributed only 0.1 percent cover.

The Stormy Creek Parcel has experienced less modification than Cottonwood Flats. The northern boundary, east of the river, is part of an area considered to be a reference reach for the Entiat River. West of the river, there has been logging and fires on the property. The field west of the parking area and an area west of the road at the north boundary were mowed for hay until approximately 2001. In 2004, the northern hayfield was covered with black cottonwood saplings that sprouted naturally. Since the acquisition, volunteers have removed thistle and planted shrubs in the field by the parking area.

Polygon 15: This grassy field is higher and drier than Polygon 14, and includes sparse coniferous trees, roads, and a house. Vegetation Condition Class E.

Polygon 16: Sparse coniferous forest burned in the fires. Expect that the vegetation in this polygon is Condition Class C.

Figure 4-8 shows the location of the following transects. Each transect described below contains the data for calculating the Condition Class and the non-native percent cover.

Transect 1: Herbaceous transect on Stormy Creek property

The transect is in the grass area south-southwest of the parking area. It is an old hay field in the center of the oxbow. The edges are mostly shrubs and there have been a few plantings. The north section of the oxbow is actively eroding.

Meters from Origin	Tag No.	Latitude N 47° 49' (seconds)	Longitude W 120° 25' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	40	17.1	31.0	4.6	Stake directly under tag on NE side of lone Douglas-fir at western edge of field.
3m	-	17.0	30.9	5.2	-
16	-	17.2	30.3	7.6	-
32	-	16.8	29.5	6.1	-
55	-	16.5	28.7	9.1	-
81	-	16.2	27.3	8.2	-

MC-10 Habitat Protection Projects

02-1669 (continued)

Transect 2: Shrub and herbaceous transect on Cottonwood Flats property

Note: *Populus balsamifera* was included in the shrub height of the plot data.

Meters from Origin	Tag No.	Latitude N 47^{o} 48' (seconds)	Longitude W 120^{o} (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	41	47.8	25' 2.6	4.6	Stake is beneath the tree tag on the NE side of the tree.
21m	42	48.1	25' 1.7	9.4	No tree tag, only stake.
33	-	48.5	25' 1.3	5.2	
56	-	48.8	25' 0.4	5.8	
67	-	48.7	25' 0.2	9.4	
77	-	49.4	24' 59.5	7.6	

Above: Transect looking east

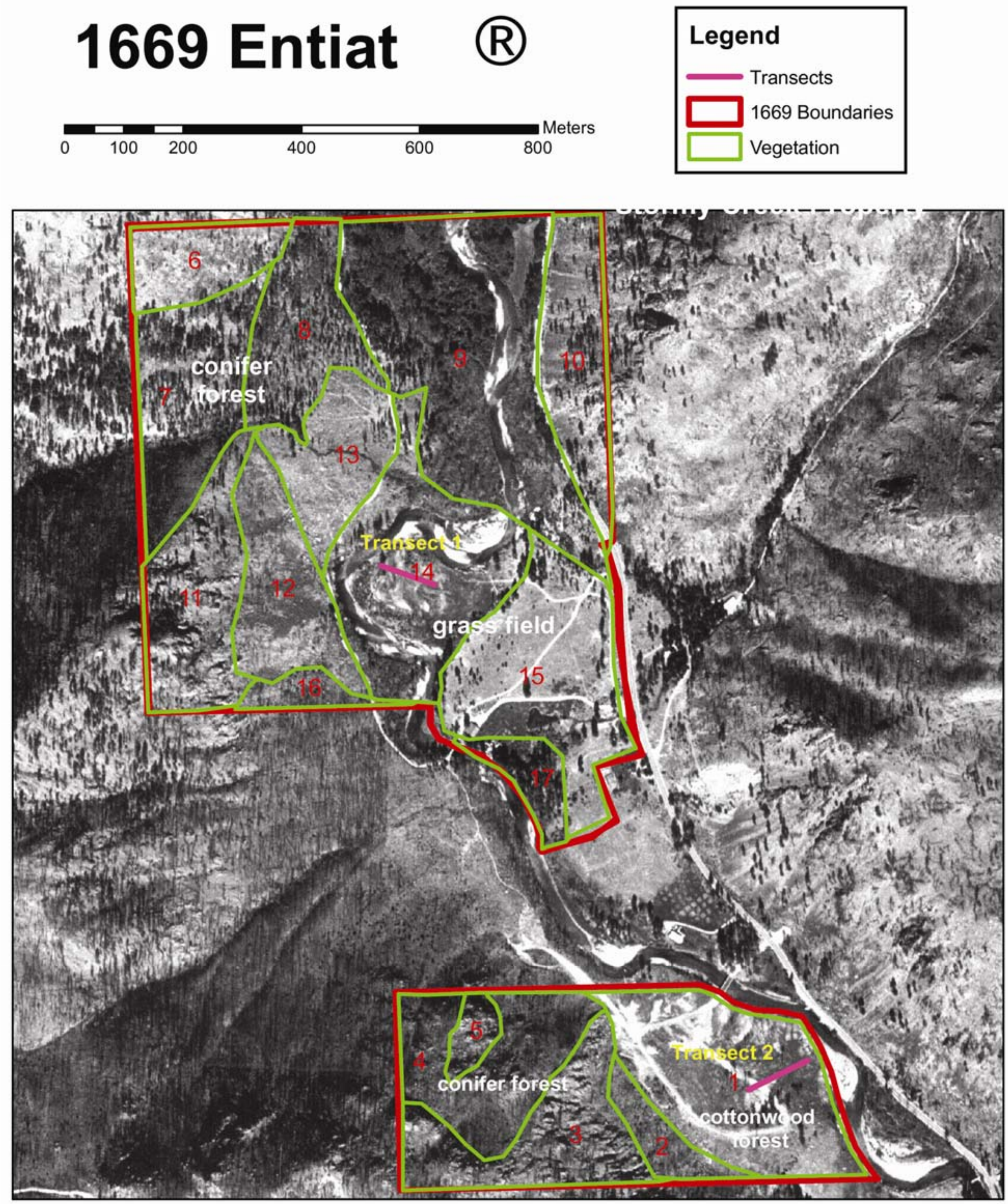


Figure 4-8. Vegetation Polygons and Transects from the Entiat River Habitat Acquisition

MC-10 Habitat Protection Projects

02-1788A Rock Creek/Ravensdale Retreat Protection

Above: Looking downstream at the top of the biological survey reach.

Location: King County. Maple Valley. Tributary to lower Cedar River.

GPS Coordinates				
REACH		Upstream		Downstream
Acquisition	lat	47 21 10.1	lat	47 21 13.9
	long	121 57 36.6	long	121 57 40.1

Objective/Intent: Assist in protecting approximately 204 acres along Rock Creek, including 1.6 miles of Rock Creek, palustrine forested and scrub-shrub wetlands, pond habitats, and second-growth forest. This would benefit Chinook, sockeye, and coho salmon, and steelhead, as well as protecting a wildlife corridor for elk, bear, and cougar. Rock Creek provides important tributary spawning habitat in the lower Cedar River. This project will acquire approximately 100 acres, including about one mile of Rock Creek and perform a complete appraisal for the entire reach.

Exceptions: Rock Creek was dry at the time of the biological survey, thus fish and invertebrate data were not collected. Physical habitat data were collected in the dry streambed and width was measured at bankfull width (BFW).

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics	
Variable [1/]	**Data**
Mean Residual Pool Vertical Profile Area (m^2)	0.00
Mean Residual Depth (cm)	0.00
Volume of LWD (m^3)	1.09
Percent Fines (%)	32.00
Percent Embedded (%)	87.43
Reach Length (m)	150.00
Reach Width (m)	2.58 (BFW)
Riparian Characteristics	
Canopy Density (1-17)	16.53
Riparian Vegetation Structure (%)	64.00
Bank Erosion (%)	0.00
Riparian Plant Characteristics	
Non-native Herbaceous Cover (%)	7.37
Non-native Shrub Cover (%)	2.27
Coniferous Basal Area (ft^2/acre)	151.06
Coniferous Density (stems/acre)	427
Deciduous Basal Area (ft^2/acre)	13.47
Deciduous Density (stems/acre)	194
Stream Organism Indices	
Fish Species Assemblage Index	N/A
Macroinvertebrate Multimetric Index	N/A

[1/] See Tables 4-1 and 4-9 for explanation of variables. Data collected July 14, 2004.

Project Sponsor: King County Water and Land Resources Division
Contacts: Jean White, Connie Blumen, Don Harrig

02-1788A (continued)

Upland Vegetation Summary

Polygons described below are mapped in Figure 4-9.

Polygon 1: Mixed deciduous and conifers, shrubby and open areas, at the extreme west end of the property. Condition Class C/D, altered by logging.

Polygon 2: Homogeneous conifer stand, dominated by Douglas-fir, but with abundant western hemlock in small size classes, almost certainly a plantation. A few trees were cored, placing the stand age at around 30 years. Condition Class C/D, altered by logging and possibly planting, but developing healthy forest conditions.

Polygon 3: Clearcut approximately 10 years ago and replanted, severely altered, but with surprising native diversity, moderate weed coverage. Expected to rapidly improve in conditions. Condition Class D.

Polygon 4: Deciduous forest, including around a large wetland and willow riparian areas along Rock Creek. Area has been harvested and crossed by what appears to be a former spur rail line and logging roads. Condition has improved since disturbance and recovery is well established. Condition Class C.

The transects described below are mapped in Figure 4-9.

Transect 1: Forested transect in 30-year-old clear cut

Transect Heading: North 0^{o}

Meters from Transect Origin	Tag Number	Latitude 47^{o} 21' (seconds)	Longitude 121^{o} 57' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	28	17.5	41.6	7.6	Below tag, W of 0.3m dbh tree. Tag is visible from path when walking east
2	29	17.5	41.6	7.6	0.9m W of tree
16	30	18.0	42.0	5.5	1.5m E of tree
32	31	19.6	42.1	8.2	3.0m SE of tree. Tree tag is about 8 feet S of trail that crosses transect
62	32	19.6	42.1	4.9	2.1m N of tag on Douglas-fir
80	33	20.6	41.8	13.7	1.8 SE of tree

MC-10 Habitat Protection Projects

02-1788A (continued)

Transect 2: Forested transect in 10-year-old clear cut

Transect Direction: 225°

Meters from Transect Origin	Tag Number	Latitude 47° 21' (seconds)	Longitude 121° 57' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	34	20.0	27.2	4.8	0.6m NE of tag on ~21.3m Douglas-fir
17	35	19.6	27.7	5.5	1.8m N of tag on Douglas-fir
31	36	19.3	28.0	4.0	2.4m E of tag on Douglas-fir
42	37	19.1	28.5	4.0	3.4m NE of tag on Douglas-fir
70	38	18.3	29.3	3.7	1.8m SE of tag on Western hemlock
82	39	18.0	29.9	9.8	3.2m ESE of tag on Douglas-fir

Above: View of the vegetation at Rock Creek Ravensdale Acquisition

02-1788A (continued)

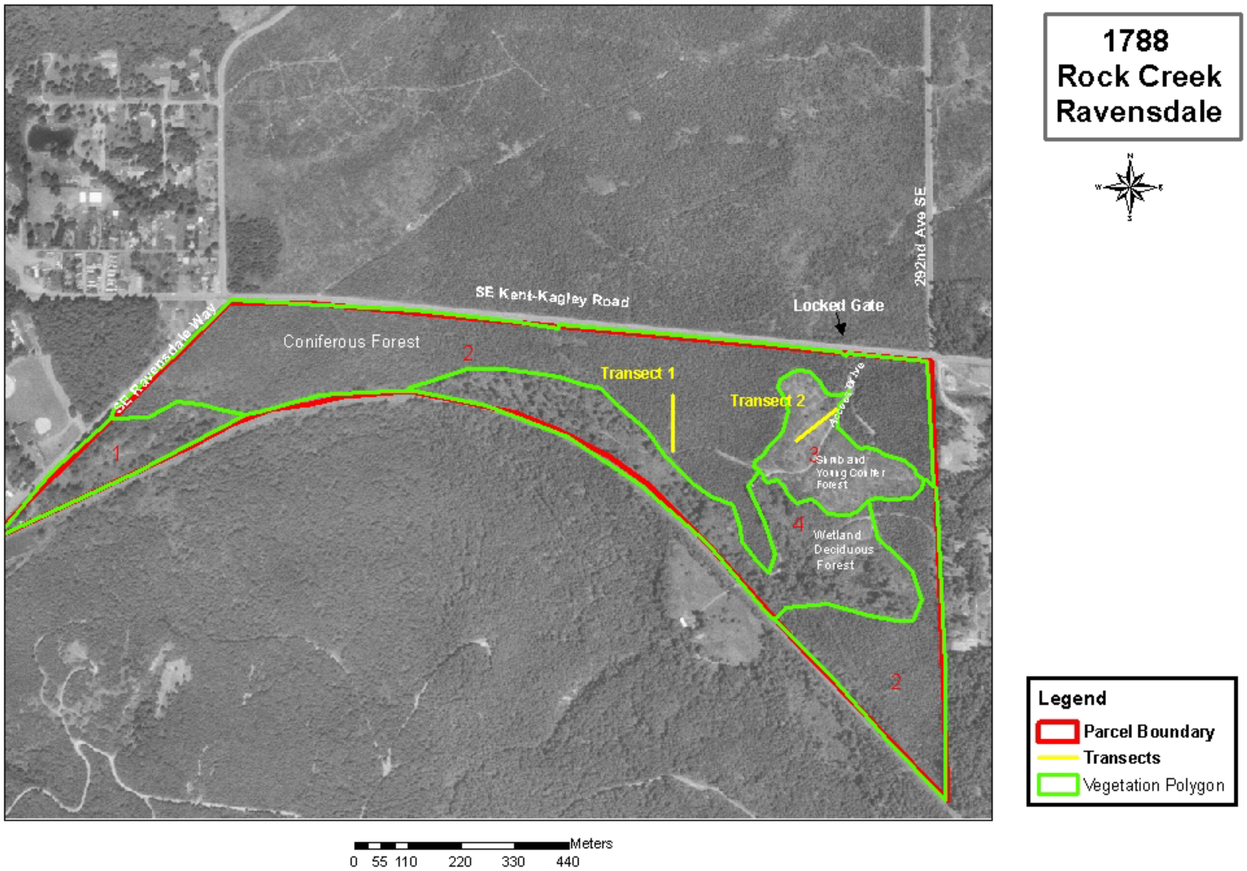


Figure 4-9. Polygons and Transects at Rock Creek Ravensdale Acquisition

MC-10 Habitat Protection Projects

02-1841 Metzler Park Side Channel Acquisition

Above: View of the sample reach
Below: Coho salmon juveniles underneath large woody debris

Location: King County, Metzler Park Side Channel, Green River.

GPS Coordinates				
REACH	Upstream		Downstream	
Acquisition	lat	47 16 59.3	lat	47 16 54.8
	long	122 5 31.9	long	122 5 41.7

Objective/Intent: The objective of this project is to purchase four parcels on existing side channel that provide high-quality riparian habitat adjacent to Metzler Park. Acquisition will allow the Green River to continue its natural migration and protect two other side channels that are connected to the Green River from bank revetment. This project will preserve up to 75 acres of habitat with intact ecological processes including portions of two side channels to the Green River that provide habitat to juvenile and adult salmonids.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Stream Physical Characteristics	
Variable[1/]	**Data**
Mean Residual Pool Vertical Profile Area (m^2)	27.00
Mean Residual Depth (cm)	10.80
Volume of LWD (m^3)	0.73
Percent Fines (%)	16.00
Percent Embedded (%)	52.09
Reach Length (m)	250.00
Reach Width (m)	13.59
Riparian Characteristics	
Canopy Density (1-17)	16.67
Riparian Vegetation Structure (%)	100
Bank Erosion (%)	2.92
Riparian Plant Characteristics	
Non-native Herbaceous Cover (%)	3.90
Non-native Shrub Cover (%)	2.92
Coniferous Basal Area (ft^2/acre)	19.91
Coniferous Density (stems/acre)	48
Deciduous Basal Area (ft^2/acre)	163.00
Deciduous Density (stems/acre)	174
Stream Organism Indices	
Fish Species Assemblage Index	80
Macroinvertebrate Multimetric Index	42

[1/]See Tables 4-1 and 4-9 for explanation of variables.
Data collected August 11, 2004.

Project Sponsor: King County Department of Natural Resources and Parks
Contacts: Josh Kahan, Connie Blumen Scott Snider
Landowner: King County Department of Natural Resources and Parks

02-1841 (continued)

Upland Vegetation Summary

The vegetation of the Metzler Park acquisition is a homogeneous riparian forest, with fairly high species diversity and few non-native species. One area along the northern boundary, parallel to the river side channel, is open with higher proportion of non-native species, including Scots broom. The polygon shown in Figure 4-10 is rated Condition Class B/C. The end of the parcel that extends south across the river was not visited; this area includes cobble river deposits with little vegetation.

Transect 1: Mature *Populus balsamifera* forest (Figure 4-10).

The transect origin is 16 meters at 145 degrees from the POBA tagged with no. 79. The origin tree is tagged with no. 80. It is a 19-inch dbh POBA that is adjacent to an 8-inch dbh *Abies grandis*.

Transect Heading: 210^{o}

Meters from Transect Origin	Tag Number	Latitude 47^{o} 16' (seconds)	Longitude 122^{o} ^{0}5' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	80	59	31.9	7	Below tag on S side of 0.5 m dbh POBA
10	86	58.8	32	6	1 m E of tag on 0.2 m dbh POBA
26	87	58.5	32.1	8	1 m W of tag on 0.2m dbh POBA
40	88	58.2	32.7	8	2 m SSW of tag on 0.5 m. dbh POBA. Tagged POBA is at 38 m on transect.
52	89	58.2	33	7	0.3 m NW of 0.5 m dbh POBA. Stake is 0.2m NW of transect line (root was in the way).
76	90	57.8	34.3	11	3 m SSW of 0.1 m dbh CONU

MC-10 Habitat Protection Projects

02-1841 (continued)

Above: Sample reach in Metzler Park

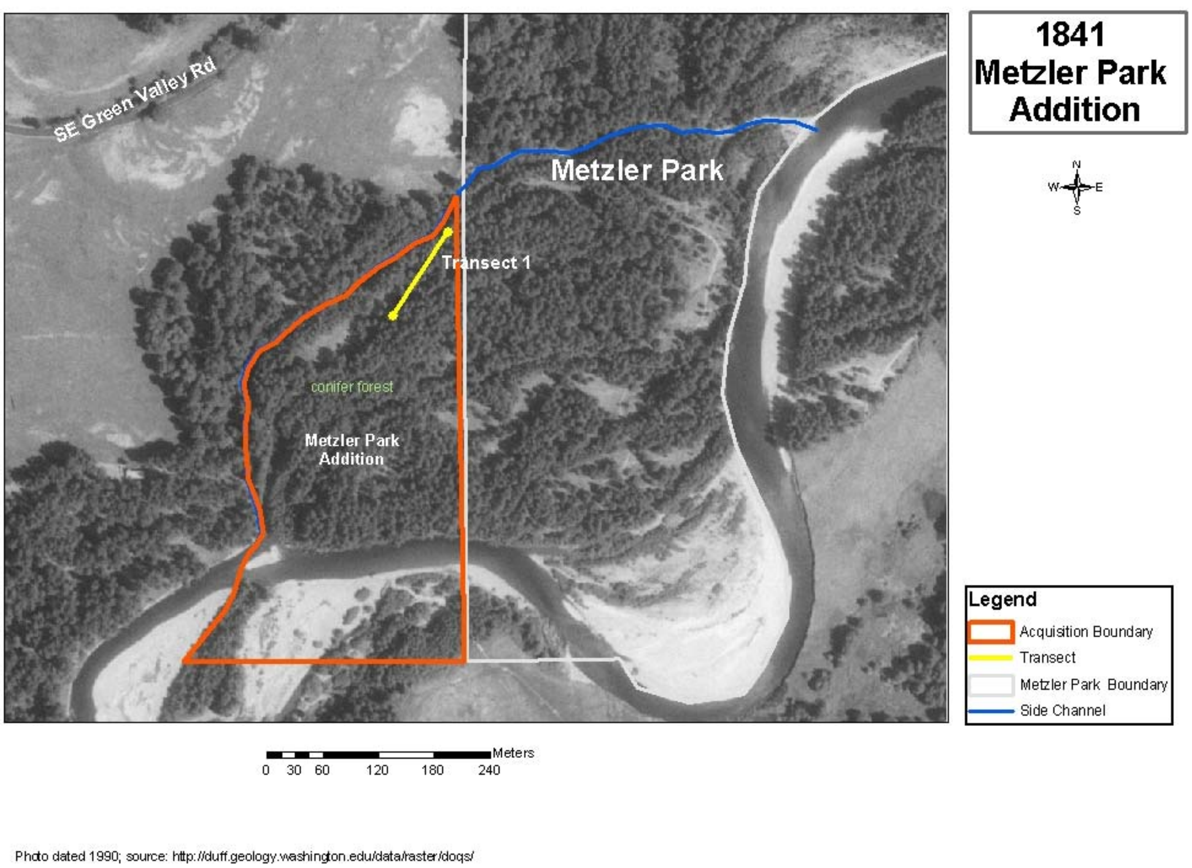


Figure 4-10. Polygon and Transect in the Metzler Park Side Channel Acquisition

MC-10 Habitat Protection Projects

02-1485A Chimacum Creek Estuary Riparian Acquisition

Above: Aerial view of acquisition.

Location: Jefferson County.

GPS Coordinates	
Transect 1	
lat	48 02 59.8
long	122 46 13.8

Objective/Intent: This project will acquire 15.3 acres of high-quality forested riparian habitat in the Chimacum Creek Estuary. The project will protect one of the most undisturbed estuary riparian areas within Hood Canal and the Straits of Juan de Fuca that is at risk of development. This acquisition will also protect adjacent marine shoreline by preserving a significant block of steeply sloped marine headlands. The adjacent riparian habitat and key uplands along the ravine are rapidly developing.

Exceptions: This property did not contain aquatic habitat within the boundaries (Figure 4-11) so no estuary variables are reported.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Estuary Characteristics	
Variable [1/]	**Data**
Percent Cover Algae (%)	N/A
Length of Algae (m)	N/A
Percent Cover Non-Native Vascular Plant (%)	N/A
Length of Non-Native Vascular Plant (m)	N/A
Percent Slope (%)	N/A
Percent Fines (%)	N/A
Length of Fine Sediment (m)	N/A
Upland Plant Characteristics	
Non-native Herbaceous Cover (%)	0.00
Non-native Shrub Cover (%)	0.00
Coniferous Basal Area (ft^2/acre)	184.39
Coniferous Density (stems/acre)	111
Deciduous Basal Area (ft^2/acre)	116.28
Deciduous Density (stems/acre)	185

[1/]See Tables 4-9 and 4-1 for explanation of variables.
Data collected July 27, 2004.

Project Sponsor: North Olympic Salmon Coalition
Contact: Paula Mackrow
Landowner: Maurice Egan, Family Trust

02-1485A (continued)

<u>Upland Vegetation Summary</u>

Polygons described below are mapped in Figure 4-11.

Mixed Forest

Almost all of the property at this site is a dry mixed conifer and broad-leaved forest. There are a few non-native species, including English ivy. While timber harvest occurred in the past, the site has not been disturbed for many years and has mostly recovered. Condition Class C, the site could continue to improve as the forest matures, or it could decline in condition if the ivy continues to increase.

Former Cabin Site

In the western and northern part of the parcel is the site of a former cabin and clearing. Most of this area has grown up to alder forest, with some non-native species, including holly. Condition Class D.

Transect 1: *Arbutus menzeisii* / *Pseudotsuga menzeisii* forest

Origin Location: The origin is a large *Arbutus menzeisii* on the edge of the cliff. Take the path 200 to 300 feet and then walk east to the cliff.

Transect Heading: 295 ^{o}

Meters from Transect Origin	Tag Number	Latitude 48 ^{o} (seconds)	Longitude 122 ^{o} 46’ (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	73	02’ 59.8	13.8	7	Beneath tag on ARME
11	74	02’ 59.9	14.2	7	1 m E of tag on PSME
33	75	03’ 0.0	15.3	6	2 m E of tag on ARME
56	76	03’ 0.6	16.5	11	1 m N of tag on PSME. Segment begins at edge of footpath
67	77	03’ 0.6	16.6	7	2 m S of tag on ARME
77	78	03’ 1.1	17.2	7	Beneath tag on PSME

02-1485A (continued)

Above: View of Vegetation at Chimacum Creek Estuary

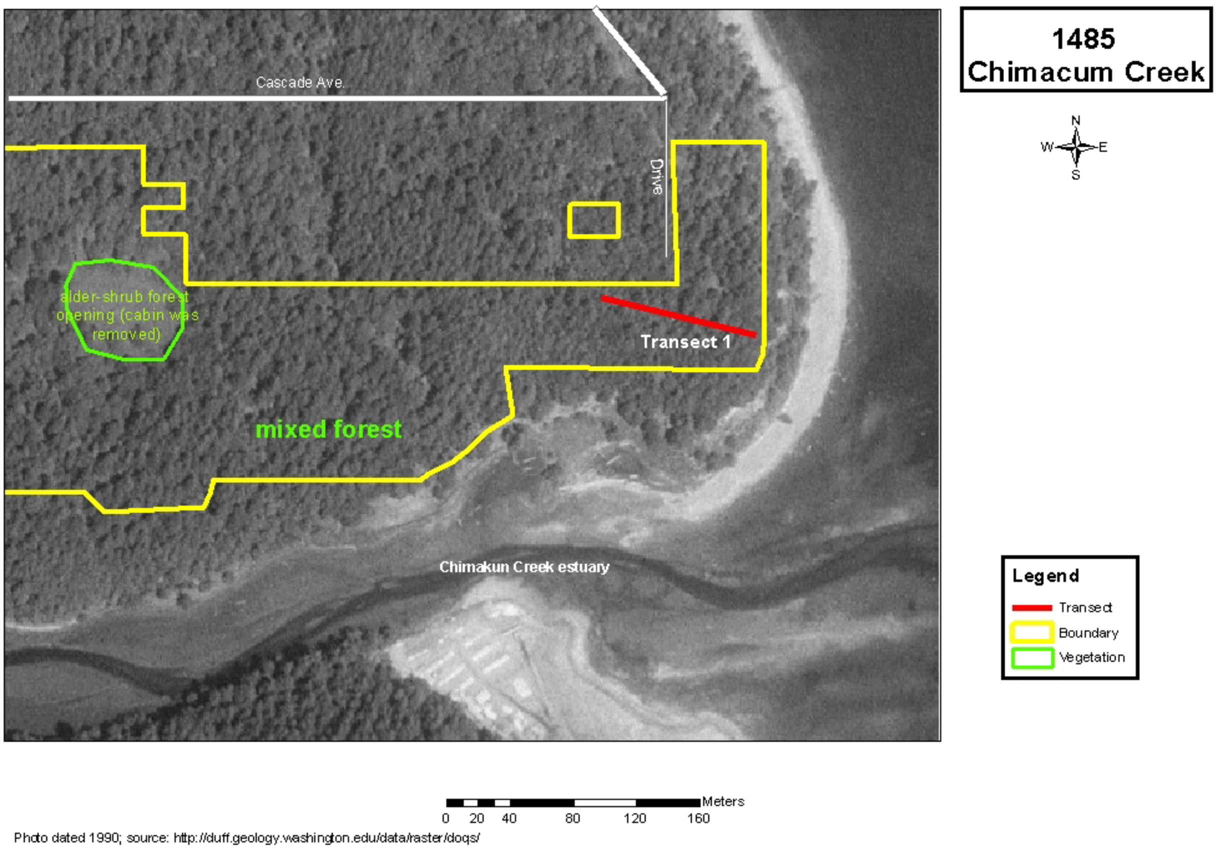


Figure 4-11. Polygons and Transects at Chimacum Creek Estuary

MC-10 Habitat Protection Projects

02-1592A Curley Creek Estuary Acquisition

Above: Vegetation at Curley Creek Estuary

Location: Kitsap County.

GPS Coordinates	
Transect 1	Transect 2
lat 47 31 16.1	lat 47 31 16.3
long 122 32 55.1	long 122 32 54.5
Transect 3	Transect 4
lat 47 31 12.5	lat 47 31 12.4
long 122 32 51.5	long 122 32 51.5

Objective/Intent: This project will preserve the Curley Creek estuary by acquiring the lands (20 acres) that comprise its entire shorelines, the surrounding steep slopes, and six adjacent upland parcels. The Curley/Salmonberry Creak system supports Chinook, coho, and chum salmon; steelhead; and cutthroat trout. Its estuary is currently in a relatively natural state and in good condition without any armoring or other development along its shoreline or slopes. Acquiring this land for conservation and educational use will protect this estuary in its natural state and preserve it for use by the diversity of salmonids that use this system and adjacent nearshore areas.

Summary Statistics for Pre-Installation Monitoring (Year 0):

Estuary Characteristics	
Variable [1/]	**Data**
Percent Cover Algae (%)	0.86
Length of Algae (m)	0.50
Percent Cover Non-Native Vascular Plant (%)	0.00
Length of Non-Native Vascular Plant (m)	0.00
Percent Slope (%)	3.45
Percent Fines (%)	7.59
Length of Fine Sediment (m)	4.40
Upland Plant Characteristics	
Non-native Herbaceous Cover (%)	0.20
Non-native Shrub Cover (%)	0.00
Coniferous Basal Area (ft^2/acre)	98.15
Coniferous Density (stems/acre)	123
Deciduous Basal Area (ft^2/acre)	96.67
Deciduous Density (stems/acre)	72

[1/] See Tables 4-1 and 4-9 for explanation of variables. Data collected July 6, 2004.

Project Sponsor: Great Peninsula Conservancy
Contact: Don Duprey
Landowner: Chester W. Whitman, Robert and Melissa Tveter, Aileen Froehlich

02-1592A (continued)

Upland Vegetation Summary

Notes refer to Polygon numbers on the vegetation map, Figure 4-12.

Polygon 1: Alder forest, predominantly with salmonberry and trailing blackberry and sword fern understory. Early successional stand, but with minimal non-native species. Condition Class C. Includes Transect 1.

Polygon 2: Mixed conifer and broadleaf forest on steep slope, some fairly large trees, probably historically logged, but not as recently as the alder forest of Polygon 1. Condition Class B/C. Includes Transect 2.

Polygon 3: Herbaceous marsh vegetation, predominantly grasses and sedges. Includes Transects 3 and 4. Condition Class C.

Polygon 4: Mixed forest, did not visit the forest on the east side of Curley Creek, but presume that it was similar in composition and condition to Polygon 2. Condition Class C.

Transects 1 and 2: Forested transect.

Origin stake is at 60 meters of the forested transect. The west portion of the transect is labeled T1 and has three segments, and the east portion of the transect is labeled T2 and has two segments. Both Transects 1 and 2 begin at 0 at the origin tree.

The origin, a 38-inch western red cedar, is close to the end of the grassy drive off of Locker Road, at the edge of the slope to the creek.

Transect 1

Transect Heading: 235 degrees, within Polygon 1.

Meters from Transect Origin	Tag Number	Latitude 47° 31’ (seconds)	Longitude 122° 32’ (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	57	16.1	55.1	11 (3D)	Stake below tag on S side of 0.97 m dbh western red cedar
6m	58	15.6	55.4	5 (3D)	Of 0.3m dbh big leaf maple
33	59	15.2	56.0	12 (2D)	Of 0.3m dbh alder
53	60	15.6	57.8	12 (3D)	

Transect 2

Transect Direction: 55 degrees, within Polygon 2.

Meters from Transect Origin	Tag Number	Latitude 47° 31’ (seconds)	Longitude 122° 32’ (seconds)	GPS EPE (m)	Stake Location from Tree Tag
16m	62,63	16.3	54.5	11 (3D)	
32	64	16.5	53.8	9 (3D)	

MC-10 Habitat Protection Projects

02-1592A (continued)

Transects 3 and 4: Herbaceous transects in estuary, within Polygon 3.

The herbaceous transect is in two parts due to the shape of the area affected by the tide. Transect 3 is has a bearing of 30 degrees, reaching from the forest edge and angling to the stream, almost perpendicular to the stream. Transect 4 begins at the 25-meter point on Transect 3 with a bearing of 350 degrees.

Only the origin for Transect 3, in the forested edge of the estuary, has rebar and tags. Stakes were not placed in the herbaceous estuarine vegetation. All other segments should be located using a compass and measuring tape.

Transect 3

Transect Heading: 30 ^{o}

Meters from Transect Origin	Tag Number	Latitude 47 ^{o} 31' (seconds)	Longitude 122 ^{o} 32' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
Origin	60	12.5	51.5	13	Stake is below tag on S side of grand fir
22	-	11.8	51.7	9	
36	-	12.3	51.4	9	

Transect 4

Transect direction: 350^{o}

Meters from Transect Origin	Tag Number	Latitude 47 ^{o} 31' (seconds)	Longitude 122 ^{o} 32' (seconds)	GPS EPE (m)	Stake Location from Tree Tag
16m	-	12.4	51.5	2.1(2D)	
27	-	12.7	52.3	3.4 (3D)	
51	-	13.5	52.4	2.4 (3D)	

02-1592A (continued)

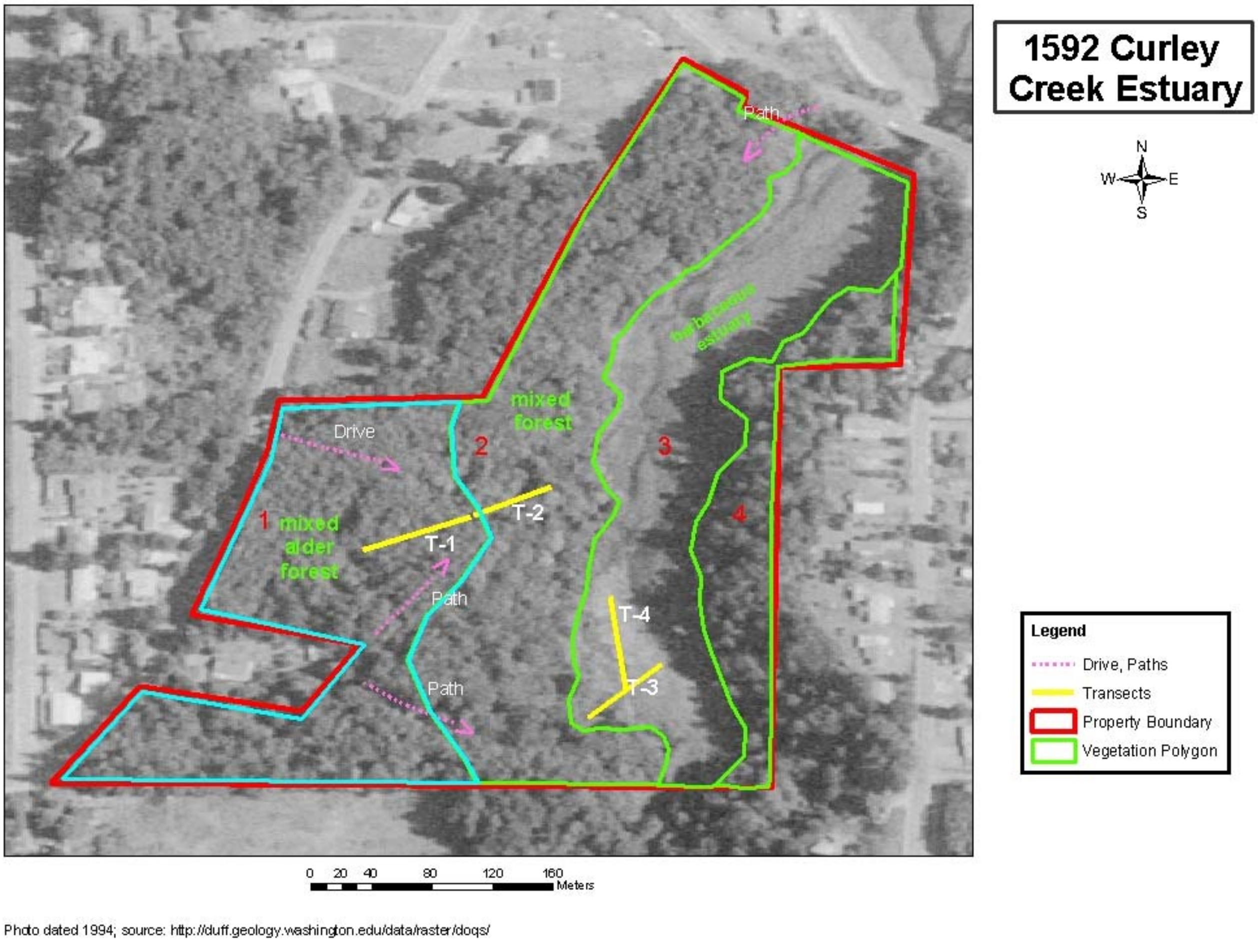


Figure 4-12. Polygons and Transects from the Curley Creek Estuary Acquisition

5. FUTURE DATA ANALYSIS

Data collected during the 2004 field season represent the before-project conditions for projects that will be implemented and represent the Year 1 conditions for habitat protection projects. Essentially, these data are the starting data point to which data collected in later field seasons will be compared. Consequently, this Annual Progress Report does not contain data analysis for the BACI design (t-tests) because the tests require 2 or more years of data. The section below describes the types of data analysis that will be performed once a second year's worth (at a minimum) of monitoring data are available.

5.1 ANTICIPATED DATA ANALYSIS METHODS

Analyses that will be performed fall into two categories: those that use statistical tests and those that that are not measured by standard statistical tests but use decision criteria.

5.1.1 Decision Criteria Analysis

No statistical tests will be applied to project types with design, function, or survival monitoring. Decision criteria will be applied to the results of these projects to determine project effectiveness.

- For fish passage projects, engineering design specifications will be assessed and the project will be determined effective if 80 percent or more of the criteria are still met by Year 5.
- AIS will be quantified and will be determined effective if 80 percent or more of the placements remain at Year 10.
- Riparian plantings will be surveyed for survival and will be determined effective if 50 percent or more of the plantings are surviving at Year 10, not including plants that are replaced.
- For livestock exclusions, the projects will be determined effective if the livestock are excluded from 80 percent of the projects after Year 10.
- For channel connectivity, the projects will be determined effective if the channels remain connected in 80 percent of the project area after Year 10.
- For spawning gravel projects, each project will be determined effective if 80 percent of the added gravel remains in place at Year 10.
- For diversion screen projects, the project will be determined effective if 80 percent or more of the design criteria are still met by Year 5.

5.1.2 Statistical Analysis

Statistical analysis used will include standard pair T-tests, which will be used for most project types, and regression analysis and non-parametric analysis, which will be used only for habitat protection projects.

5.1.2.1 T-tests

Those monitoring activities that follow the BACI design will have similar data analysis procedures using a paired t-test. The procedure will be similar among project types except for the indicator, metrics, and the number of years for effectiveness determination.

For fish passage projects, juvenile salmon will be measured in number of juvenile fish per square meter by species, and adult salmon will be measured in number of spawners per kilometer or redds per kilometer by species. For these data, the difference in the project mean between the control and impact reaches in Year 0 (d_0) will be compared to the difference between the control and impact reaches in Year 1 (d_1). The difference between (d_0) and (d_1) across all projects will be tested to see if it is significantly greater than 20 percent of (d_0). This one-sided paired t-test will use an alpha level of 0.05. The decision criteria of a 20 percent change will be applied each year through Year 5 to determine if the project has been effective in increasing numbers of fish in the impact reach as compared to the control reach.

For in-stream structures, the mean residual pool vertical profile area (in square meters), the mean residual depth (in cm), and the number of juvenile salmon (in fish per square meter by species) will be compared using the paired t-test described above. The decision criteria of a 20 percent change will be applied at each year through Year 10 to determine if the project has been effective in increasing the metrics listed above in the impact reach as compared to the control reach.

For riparian plantings, mean percent canopy (score from 1-17), and three-layer riparian vegetation presence (percent) will be compared using the paired t-test to determine if a 20 percent increase has occurred by Year 10.

For livestock exclusions, mean percent canopy (score from 1-17), and three-layer riparian vegetation presence (percent), and linear proportion of actively eroding banks (percent) will be compared using the paired t-test to determine if a 20 percent increase has occurred by Year 10.

For constrained channels, mean residual pool vertical profile area (in square meters), the mean residual depth (in cm), and the mean bankfull cross sectional area (in square meters) will be compared using the paired t-test to determine if a 20 percent increase has occurred by Year 10.

For channel connectivity projects, mean residual pool vertical profile area (in square meters), the mean residual depth (in centimeters), mean percent canopy (score from 1-17), three-layer riparian vegetation presence (percent), and the number of juvenile salmon (in fish per square meter by species) will be compared using the paired t-test to determine if a 20 percent increase has occurred by Year 10.

For spawning gravel projects, the percent gravel embedded at the mid-channel margins, the percent substrate embedded, the percent substrate as fines, and the number of spawners per kilometer or redds per kilometer by species will be compared using the paired t-test to determine if a 20 percent increase has occurred by Year 10 (see Table 4-2, SRFB MP-0).

5.1.2.2 Data Analysis for Habitat Protection Projects

Statistical analyses will be performed for the habitat protection projects in both freshwater and estuary habitat once multiple years of data are available for a given project. The analyses will include simple linear regression to test for significant trends in response indicators across all projects and years. This method has been shown to be more effective than the sign test described in Crawford and Arnett (2004). In the current method procedure document for monitoring acquisitions (Crawford and Arnett 2004), the method for testing for significant regional trends (i.e., consistent trends among multiple sites) is based on methods developed by N. Scott Urquhart and others (1998) for EPA's EMAP program. This choice was appropriate for *a priori* statistical power analysis, and it is a theoretically correct method that can be properly applied to the analysis of trends for this SRFB program. As with all statistical procedures, however, the appropriate test should be selected based on the specific application.

The EMAP method requires calculating components of variance for the random effects in the model, including site effects, year effects, interaction effects, and effects due to all other causes, usually called index or residual effects. Interaction effects are generally not estimable unless sites are visited multiple times within one year, so these are usually included in the residual variance term (Urquhart et al. 1998). The other components of variance are estimable using a suite of methods available in some statistical computer software packages. The methods yield different results, and most require some sort of normality assumption, although it is possible to calculate the components non-parametrically. This non-parametric method is not readily available in most statistical software. Details on the best methods for the analysis of trends under different scenarios are still under development by EPA statisticians and others (Urquhart, 2004, personal communication).

Selecting the correct methods for variance components can be complicated, and a long time record may be needed to form stable estimates. A simpler way to look at regional trends is by framing the problem as a profile summary among sites. Sites are then independently selected replicates from the population, and repeated measures are taken at each site. After three or more samples are taken over time, each site is represented by a regression slope, or profile. If we assume that these slopes are independent among sites, and that they are representative of an average population slope, then the average slope can be tested for differences from zero with a simple t-test (or non-parametric analog if necessary). The two approaches are fundamentally the same, and require the same sampling strategies.

The profile summary approach is planned for avian and vegetation trend monitoring in national parks in the North Coast and Cascades Monitoring Network. Recent workshops and academic meetings between statisticians working on EMAP protocols and U.S. Geological Survey (USGS) and TerraStat Consulting statisticians working on the national park monitoring programs have concluded that the only disadvantage this approach has over the more complex EMAP design would occur if the slopes are not independent among sites. This lack of independence would occur if there were significant random year effects. Random year effects are generally weather-related differences among years that would affect all sites similarly. The stream morphology variables used for statistical power analysis for the SRFB acquisitions showed very small year effects. However, other variables such as fish assemblages and riparian condition might be more prone to large-scale weather impacts such as annual rainfall. For the national parks program, it was determined that these random year effects, if present, were an acceptable part of the monitored trend. For example, if a common weather pattern affects all sites and results in a long-term regional trend, this trend is still of importance to the monitoring program. The cause of the trend is unknown, and could be purely related to weather, but it is a trend nonetheless. If this accommodation also applies to the SRFB program, then the simpler profile summary method is a more flexible and transparent option. Namely, it is much simpler to apply and understand with even basic statistical software. Slope estimates are available by site for each measured variable. In addition to the t-test for average trend, the slopes can be plotted using cumulative distribution functions or colored maps to compare different regions of the state, for example.

5.1.2.3 Evaluation of Change at Individual Sites

The sign test detailed in the procedure document for acquisitions (MC-10) requires independence among indicators. Because this is not likely to be the case using the complete list of measured indicators, an independent list must be developed. We have previously recommended principle components analysis (PCA) as a possible method to reduce the indicators to a smaller set of independent variables. However, there are not enough acquisition sites with data to make PCA possible at this time. Another possibility might be to use best professional judgment to select a set of indicators that could reasonably be assumed independent.

The sign test is a relatively low-power test, which gives an indication of only the direction, rather than the magnitude, of the trends or changes within the site. The method for trend detection outlined above suggests another possibility, which would include an indication of the magnitude of the changes in comparison to other sites in the sample. The slopes for individual indicators could be scaled to the average slope among sites (e.g., slope for site A for Mean Residual Depth is 1.2 standard deviations above the average Mean Residual Depth slope; for Fish IBI it is 0.9 standard deviations above the average trend slope). These scaled slopes could be compared across indicators for each site. If a particular site had positive scaled slopes for all indicators, for example, it is performing better than the other sites in the sample. Sites with all negative scaled slopes would be considered under-performing sites. Because these values have been scaled for each indicator, a parametric test for differences from zero (i.e., a t-test) could be considered. Note that this method does not change the requirement for independence among indicators.

Based on the sample variances, statistical power analysis will be used to determine how many samples would be needed to detect a 20 percent improvement in the mean percent canopy (score from 1-17), three-layer riparian vegetation presence (percent), linear proportion of actively eroding banks (percent), mean residual pool vertical profile area (in square meters), mean residual depth (in centimeters), percent substrate embedded, percent substrate as fines, volume of large wood (cubic meters), mean bankfull cross sectional area (in square meters), macro invertebrate IBI, fish IBI, the parameters measured for upland vegetation, and the parameters measured for estuary habitat.

For all project types, variances for each indicator will be calculated and a power analysis will be conducted to determine if a sample size of ten will achieve the identified precision requirement.

6. COST ANALYSIS

6.1 ESTIMATED COSTS (FROM PROPOSAL) BY PROJECT CATEGORY

General Field Prep	Fish Passage	In-stream Structures	Riparian Plantings	Acquisitions	Livestock Exclusions	Connected Channels	Constrained Channels	Spawning Gravel	Diversion Screening
$9,540	$149,118	$67,106	$27,180	$102,234	$5,306	$26,888	$8,618	$19,684	$4,888

Project Management, Meetings, and Presentations	Administration	Permitting	Equipment	Training	Data Setup and Management	Per Diem	Vehicles	Data Analysis and Lab Costs	Report Writing and Production
$43,934	$8,760	$5,250	$30,800	$11,720	$19,780	$84,480	$14,850	$22,110	$37,155

TOTAL BUDGET: $699,595

6.2 ACTUAL COSTS BY PROJECT CATEGORY AS OF 1/28/05

General Field Prep	Fish Passage	In-stream Structures	Riparian Plantings	Acquisitions	Livestock Exclusions	Connected Channels	Constrained Channels	Spawning Gravel	Diversion Screening
$22,611	$14,862	$17,657	$8,091	$81,070	$4,702	$5,849	$2,906	$0	$170

Project Management, Meetings, and Presentations	Administration	Permitting	Equipment	Training	Data Setup and Management	Per Diem – Vehicles	Data Analysis and Lab Costs	Report Writing and Production
$18,607	$10,374	$3,447	$17,008	$15,356	$38,393	$19,097	$7,699	$14,857

Total Costs (January 28, 2005): $302,812

6.3 EXPENSES IN 2004 VS. OVERALL BUDGET

General Field Prep	Fish Passage	In-stream Structures	Riparian Plantings	Acquisitions	Livestock Exclusions	Connected Channels	Constrained Channels	Spawning Gravel	Diversion Screening
237.01%	9.97%	26.31%	29.79%	79.30%	88.62%	21.75%	33.72%	0.00%	3.48%

Project Management, Meetings, and Presentations	Administration	Permitting	Equipment	Training	Data Setup and Management	Per Diem – Vehicles	Data Analysis and Lab Costs	Report Writing and Production
42%	118%	66%	55%	132%	191%	19%	35%	40%

Percent of Total Budget: 43%

7. ACKNOWLEDGEMENTS – DATA ASSISTANCE, PROJECT SPONSORS

Assistance from project sponsors and staff from agencies has enhanced the success of this program. A sincere thanks goes to the following individuals and organizations who have contributed to the program:

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- Richard Southworth, City of Centralia
- Ron Craig, Willapa Bay Regional Fisheries Enhancement Group
- Paula Mackrow, North Olympic Salmon Coalition
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- Jim White, Underwood Conservation District
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- Joe Fitting and Rob Rhoads, Quinault Indian Nation
- George Walter, Nisqually River Basin Land Trust
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- Richard Jones, Walla Walla Conservation District
- Larry Otos, City of Mount Vernon
- Curt Miller, Miller Consulting
- Don Duprey, Great Peninsula Conservancy
- Dave King, WDFW
- Monty Rinder, Jefferson County
- Ed Connor, Seattle City Light
- Liane Rusnak, Landowner
- Mary Maier, King County Water and Land Resources Division

- Bob Aldrich, Snohomish County
- Dave Olson, Skagit County Dike District #3
- Katharine Bill, Methow Conservancy
- Anna Leal, Kittitas County Conservation District
- Josh Kahan, King County Department of Natural Resources and Parks
- Jean White, King County Water and Land Resources Division
- Gordon Congdon, Chelan/Douglas Land Trust

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APPENDIX A

DRIVING DIRECTIONS

APPENDIX A

DRIVING DIRECTIONS

MC-1: FISH PASSAGE PROJECTS

02-1530R: Salmon River Tributary 21-0143 Culvert Barrier

North of Hoquiam on State Route 101 to mile 137.5 (West Boundary Road, Forest Service Road 21), north 4.2 miles. Turn right on Road 2120 and proceed 0.95 miles to culvert. Control reach is located from culvert to 150 meters downstream (including 66.5 meters of mainstem Salmon River). Impact reach is located from culvert to upstream 150 meters.

02-1602R: Donkey Creek Culvert

Take State Route 101 to mile 146. Turn onto Clearwater Road and proceed for 1.3 miles where a Queets Ridge Road turns off to the right. The culvert is just before this road. Control reach is from the culvert to 150 meters downstream. Impact reach is from culvert to 150 meters upstream.

02-1574: Melaney Creek Fish Passage Project

From Shelton, drive north on Highway 3. Turn right onto Agate Road after you get to the north end of Oakland Bay. Drive past Pioneer Elementary School. The stream crossing is about three-quarters of a mile from the school, at the bottom of the hill. The control reach goes from the downstream end of the culvert, to 210 meters downstream and ends at a low but relatively extensive log jam. The impact reach goes from the upstream end up the culvert to 210 meters upstream.

MC-2: IN-STREAM STRUCTURES PROJECTS

02-1561: Edgewater Park Off-Channel Restoration

The impact reach is located in the deciduous wooded area of the park, adjacent to gravel boat launch parking lot and toward the river from the landfill cap. The control reach is located on Cottonwood Island. Take McLean Road west from Edgewater Park. Turn south onto Penn Road and follow it until it ends in a dirt parking lot. Walk past the gate and follow road until a channel opens up in the woods to your right. This is the upstream end of the control reach for this project.

02-1444R: Little Skookum Valley, Phase II Riparian

From Shelton: south on Highway 101, East on Highway 108, left on Hurley-Waldrup Road, right on Eich Road, approximately one-quarter mile down dirt road and downstream of culvert replacement site. Control reach is located from flat wooden bridge upstream to 150 meters. Impact reach is located from the southwest corner of the Allison's hay field upstream to 15 feet downstream from a 20 year alder stand that is downstream of the wooden bridge that delineates the downstream boundary of the control reach.

02-1463R: Salmon Creek

The project area may be accessed from Highway 4 by turning north on Salmon Creek Road and continuing approximately 10 miles to the bridge crossing Salmon Creek. The impact reach is located just downstream from the bridge.

02-1515: Upper Trout Creek Restoration

The project area may be accessed from Highway 14 by turning north on the Wind River Highway (through Carson, Washington), continuing approximately 8 miles, then turning west on Hemlock Road. Go approximately one-half mile on Hemlock Road and turn north on Szydio Road. Drive until Szydio Road splits into Forest Service Road 5400. Follow the 5400 Road for approximately 3 miles to the 4200 Road junction. Follow the 4200 Road for approximately 2.5 miles to the 3300 Road. Follow the 3300 Road for 0.5 miles until you cross Trout Creek, then continue approximately 1.2 additional miles until you cross Crater Creek. Both the impact and control sampling reaches are located on Crater Creek. The control reach is located just upstream from the 3300 Road crossing and the impact reach is located approximately 1.3 miles downstream (approximately 800 feet upstream from the confluence with Trout Creek).

MC-3: RIPARIAN PLANTING PROJECTS

02-1561: Edgewater Park Off-Channel Restoration

The impact reach is located in the deciduous wooded area of the park, adjacent to gravel boat launch parking lot and toward the river from the landfill cap. The control reach is located on Cottonwood Island. Take McLean Road west from Edgewater Park. Turn south onto Penn Road and follow it until it ends in a dirt parking lot. Walk past the gate and follow road until a channel opens up in the woods to your right. This is the upstream end of the control reach for this project.

02-1446-R: Centralia Riparian Restoration Project

From Highway 99, head south to the Lewis County line. Turn right onto Goodrich Road and follow to the end at the gate. Site is straight ahead.

02-1616R: Vandersar Restoration

Go north on Highway 9 turn left onto the South Skagit Hwy at the Park & Ride. Proceed east (under Hwy 9 bridge) and go 6 miles east to the Vandersar Dairy (left side of road). The third driveway west (before) the dairy is the Rusnak driveway. Use this driveway to access the west side of the Vandersar property. Plantings will be done on the east side of Ross Island Slough, south of the confluence with Anderson Creek. The impact reach begins a few meters north of the southern property boundary. The control reach is centered 5 meters north of the confluence with Anderson Creek.

02-1623 Snohomish River Confluence Reach Restoration

Project site is accessed from I-5, east on Highway 2. To get to the Bob Heirman Wildlife Park, from Highway 2 continue south on Highway 9. Turn east on Broadway Avenue. Follow this to Connelly Road. Take Connelly road south to the park, located on the east side of the road.

MC-4: LIVESTOCK EXCLUSION PROJECTS

02-1498: Abernathy Creek Riparian Restoration

The project area may be accessed by following State Highway 4 west from Longview (Washington) approximately 10 miles along the Columbia River, then following Abernathy Creek Road north for approximately 2.8 miles to the USFWS Abernathy Fish Technology Center. The control reach is located immediately adjacent to the center.

MC-5: CONSTRAINED CHANNEL PROJECTS

02-1625C: South Fork Skagit Levee Setback Acquisition and Restoration

From I-5, take Conway exit 221. After crossing freeway, take first right and head west over railroad tracks towards the Skagit River and La Conner. Take a right onto Dike Road before bridge. Follow Dike Road approximately 1mile. Project site begins where road leaves levee. This is approximately 2 miles downstream from where river forks. Control reach is just upstream from impact reach.

MC-6: CHANNEL CONNECTIVITY PROJECTS

02-1561: Edgewater Park Off-Channel Restoration

The impact reach is located in the deciduous wooded area of the park, adjacent to gravel boat launch parking lot and toward the river from the landfill cap. The control reach is located on Cottonwood Island. Take McLean Road west from Edgewater Park. Turn south onto Penn Road and follow it until it ends in a dirt parking lot. Walk past the gate and follow road until a channel opens up in the woods to your right. This is the upstream end of the control reach for this project.

02-1616R: Vandersar Restoration

Go north on Highway 9 turn left onto the South Skagit Hwy at the Park & Ride. Proceed east (under Highway 9 bridge) and go 6 miles east to the Vandersar Dairy (left side of road). Proceed down a dirt road till it levels out. The culvert the road goes over is the Anderson Slough. This road crossing is the “x-site” for the impact reach. The lower end of the impact reach is 120 meters downstream of this crossing. The total reach length is 180 meters. The control reach is located on Ross Island Slough and can be reached by the Rusnak property downstream. From the house, proceed through the property. There is a small island covered in reed canary grass that is approximately at the “x-site” of the control reach. This x-site is in the middle of the reach

MC-10: HABITAT PROTECTION PROJECTS

01-1353A: Logging Camp Canyon (Phase 1) Acquisition.

The project site can be reached by following State Highway 14 to Lyle (Washington) then following State Route 142 north along the east side of the Klickitat River for 10 miles to the bridge crossing. Turn left (west) on the north side of the bridge and follow the gravel road on the west side of the Klickitat River back downstream (south) for approximately 0.5 miles until you cross the Logging Camp Creek channel. The project site is located approximately 0.75 miles upstream from the gravel road crossing on Logging Camp Creek.

0202-1535R: WeyCo Marshall Shoreline Acquisition

Drive south on Highway 7 to Mashel River Bridge. Sample reach is from 20 meters downstream of bridge to 520 meters downstream. Downstream end begins just upstream from a pool.

02-1622A: Issaquah Creek Log Cabin Reach Acquisition

From I-90, take exit #17 onto Front Street in Issaquah. Front Street becomes Issaquah-Hobart Road. For the east entrance, follow approximately 5 miles and then take a right onto Cedar Grove Road and drive one-half mile. The entrance is the first driveway past SE 148th street. From the gate, follow the dirt road until you reach the cabin. The middle biological survey reach is directly to the stream from the cabin.

02-1650A: Methow Critical Riparian Habitat Acquisition

The sample reach is on the Tawlks property and can be accessed by following State Highway 20 to Mazama then following the Wolf Creek Road southeast (downstream) from Mazama for 1.6 miles to the Methow Community Trail public access area and trailhead. Follow the trail for approximately 0.5 miles southeast (downstream). The sample reach is located just upstream from the foot bridge.

02-1669A: Entiat River Habitat Acquisition.

The sample reach can be accessed by following Alt 97 to Entiat (Washington) then following the Entiat River Road north for 16.8 miles to the public access area located on the west side of the road at the mouth of Stormy Creek.

02-1788A: Rock Creek/Ravensdale-Retreat Protection

From Highway 169 East (Maple Valley-Black Diamond Highway) near Maple Valley, go east on Kent-Kangley Road at Four Corners. Follow this for approximately 4 miles. The Ravensdale-Retreat tract is on the right side of this road. Follow the gated dirt road until you get to the railroad crossing. Rock Creek goes under the road in a large concrete culvert before you get to the tracks. The railroad crosses the creek just upstream of the road. The Rock Creek stream habitat reach is from 25 meters downstream of the stream road crossing to 150 meters downstream.

02-1841: Metzler Park Side Channel Acquisition

From I-5, take State Highway 18 east. Take the Auburn-Black Diamond Road Exit. Take a right at the bottom of ramp, and next right onto SE Green Valley Road. Follow this road for several miles and look for Metzler Park King County Park sign on right. Properties are adjacent to and just downstream of park.

02-1485A: Chimacum Creek Estuary Riparian Acquisition

Jefferson County. From Highway 101, take State Route 19 toward Port Townsend. Pass Port Haddock, turn east on Prospect Avenue toward Kala Point. Turn right on Beatty, left on Hilton to end. Parcels are along bluff through forest.

02-1592A: Curley Creek Estuary Acquisition

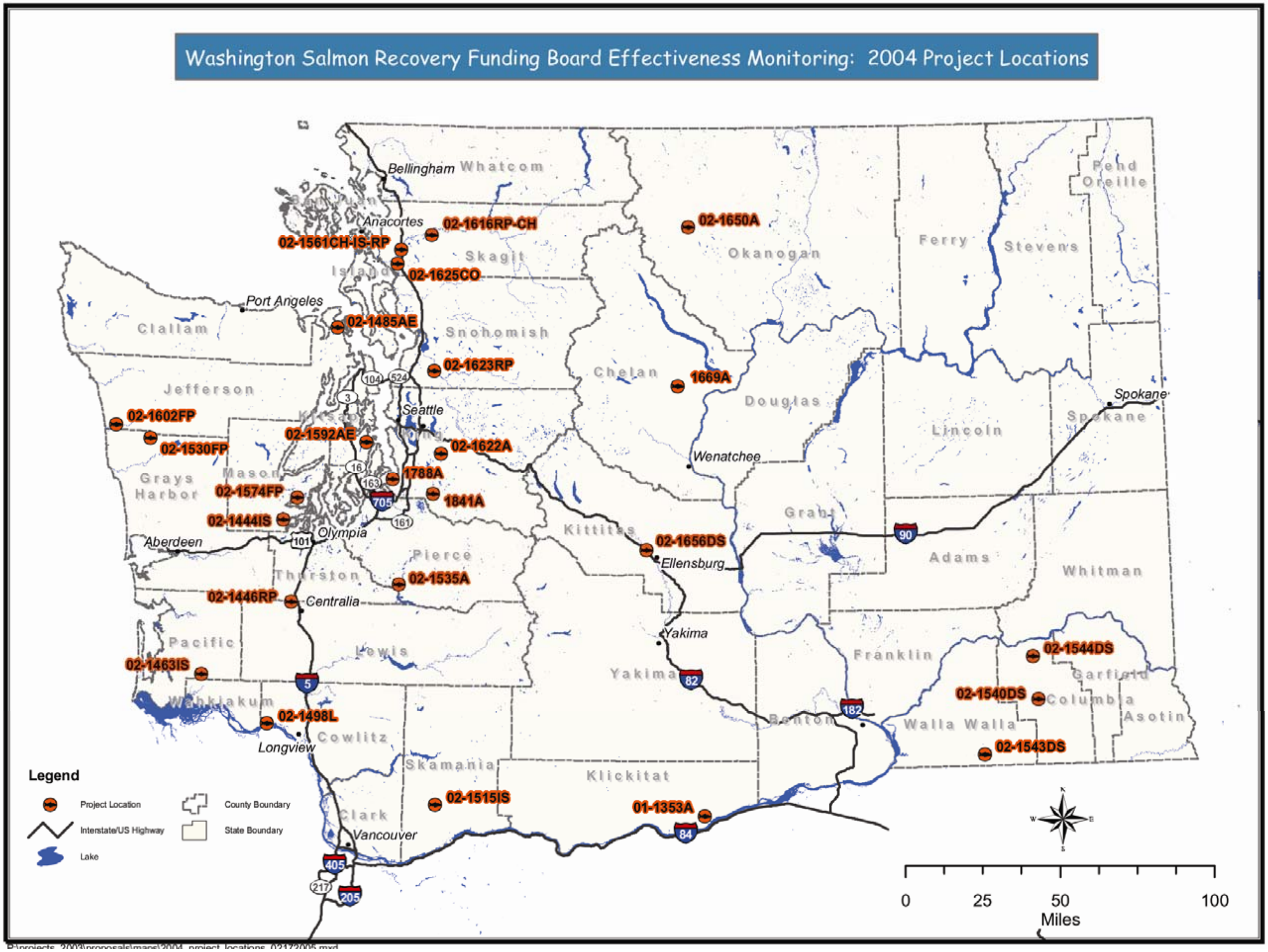
Kitsap County. Take the ferry from West Seattle to Southworth. From the ferry, take SE Southworth Drive a couple miles to Curley Creek (it is signed).

APPENDIX B

PROJECT LIST AND MAP

Table B-1. Summary of Projects Surveyed in 2004

Project No.	Project Name	Type	Fish Passage	In-Stream Structures	Riparian Plantings	Livestock Exclusions	Constrained Channel	Channel Connectivity	Spawning Gravel	In-Stream Diversions	Habitat Protection (Acquisition)
02-1353	Logging Camp Canyon	Acquisition									Y
02-1444R	Little Skookum Valley	Phase II Riparian		Y							
02-1446R	Centralia	Riparian Restoration			Y						
02-1463R	Salmon Creek	In-Stream Structures		Y							
02-1485A	Chimacum Creek Estuary	Riparian Acquisition									Y
02-1498	Abernathy Creek	Riparian Restoration				Y					
02-1515	Upper Trout Creek	Restoration		Y							
02-1530R	Salmon River Tributary	Culvert Barrier	Y								
02-1535R	WeyCo Marshal	Shoreline Acquisition									Y
02-1561	Edgewater Park	Off-Channel Restoration		Y	Y			Y			
02-1574	Melany Creek	Culvert	Y								
02-1592A	Curley Creek	Estuary Acquisition									Y
02-1602	Donkey Creek	Culvert	Y								
02-1616R	Vandersar	Restoration			Y			Y			
02-1622A	Issaquah Creek Log Cabin	Reach Acquisition									Y
02-1623	Snohomish River Confluence	Reach Restoration			Y						
02-1625	Skagit	Levee Setback and Acquisition					Y				
02-1650	Methow	Acquisition									Y
02-1669	Entiat	Acquisition									Y
02-1788A	Rock Creek/Ravensdale Retreat	Protection									Y
02-1841	Metzler Park	Side Channel Acquisition									Y


Washington Salmon Recovery Funding Board Effectiveness Monitoring: 2004 Project Locations
Bellingham
Whatcom
Anacortes
02-1616RP-CH
02-1650A
02-1561CH-IS-RP
Skagit
Island
02-1625CO
Okanogan
Ferry
Stevens
Pend Oreille
Port Angeles
Clallam
02-1485AE
Snohomish
02-1623RP
Chelan
1669A
Douglas
Jefferson
Spokane
02-1602FP
Seattle
02-1592AE
02-1530FP
02-1622A
Lincoln
Wenatchee
Grays Harbor
Mason
1788A
02-1574FP
1841A
02-1444IS
Olympia
Aberdeen
Kittitas
02-1656DS
Grant
Ellensburg
Pierce
Thurston
02-1535A
Adams
Whitman
02-1446RP
Centralia
Yakima
Pacific
Lewis
02-1463IS
Franklin
02-1544DS
Garfield
02-1540DS
Columbia
Asotin
Wahkiakum
02-1498L
Cowlitz
Longview
Benton
Walla Walla
02-1543DS
Skamania
Klickitat
02-1515IS
01-1353A
Clark
Vancouver
Legend
Project Location
Interstate/US Highway
Lake
County Boundary
State Boundary
0
25
50
100
Miles
P:\projects_2003\proposals\maps\2004_project_locations_02172005.mxd